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WFM5200
Waveform Monitor

User Manual

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Tektronix

WFM5200
Waveform Monitor

User Manual

www.tektronix.com
077-0531-02

Tektronix

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- In North America, call 1-800-833-9200.
- Worldwide, visit www.tektronix.com to find contacts in your area.

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General safety summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it.

To avoid potential hazards, use this product only as specified.

Only qualified personnel should perform service procedures.

To avoid fire or personal injury

Use proper power cord. Use only the power cord specified for this product and certified for the country of use.

Ground the product. This product is grounded through the grounding conductor of the power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product, ensure that the product is properly grounded.

Observe all terminal ratings. To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

Do not apply a potential to any terminal, including the common terminal, that exceeds the maximum rating of that terminal.

Power disconnect. The power cord disconnects the product from the power source. Do not block the power cord; it must remain accessible to the user at all times.

Do not operate without covers. Do not operate this product with covers or panels removed.

Do not operate with suspected failures. If you suspect that there is damage to this product, have it inspected by qualified service personnel.

Avoid exposed circuitry. Do not touch exposed connections and components when power is present.

Use proper AC adapter. Use only the AC adapter specified for this product.

Do not operate in wet/damp conditions.

Do not operate in an explosive atmosphere.

Keep product surfaces clean and dry.

Provide proper ventilation. Refer to the manual's installation instructions for details on installing the product so it has proper ventilation.

Terms in this manual

These terms may appear in this manual:

WARNING. *Warning statements identify conditions or practices that could result in injury or loss of life.*

CAUTION. *Caution statements identify conditions or practices that could result in damage to this product or other property.*

Symbols and terms on the product

These terms may appear on the product:

- DANGER indicates an injury hazard immediately accessible as you read the marking.
- WARNING indicates an injury hazard not immediately accessible as you read the marking.
- CAUTION indicates a hazard to property including the product.

The following symbol(s) may appear on the product:

Environmental Considerations

This section provides information about the environmental impact of the product.

Product End-of-Life Handling

Observe the following guidelines when recycling an instrument or component:

Equipment recycling. Production of this equipment required the extraction and use of natural resources. The equipment may contain substances that could be harmful to the environment or human health if improperly handled at the product's end of life. To avoid release of such substances into the environment and to reduce the use of natural resources, we encourage you to recycle this product in an appropriate system that will ensure that most of the materials are reused or recycled appropriately.

This symbol indicates that this product complies with the applicable European Union requirements according to Directives 2002/96/EC and 2006/66/EC on waste electrical and electronic equipment (WEEE) and batteries. For information about recycling options, check the Support/Service section of the Tektronix Web site (www.tektronix.com).

Perchlorate materials. This product contains one or more type CR lithium batteries. According to the state of California, CR lithium batteries are classified as perchlorate materials and require special handling. See www.dtsc.ca.gov/hazardouswaste/perchlorate for additional information.

Restriction of Hazardous Substances

This product is classified as Monitoring and Control equipment, and is outside the scope of the 2002/95/EC RoHS Directive.

Preface

This manual contains information to help you use the Tektronix WFM5200 Waveform Monitor. This information includes the following:

- How to set up various waveform displays for monitoring SD-SDI, HD-SDI, and 3 Gb/s SDI video signals.
- How to set up audio displays to monitor embedded AES/EBU audio signals.
- How to set up parameters for monitoring auxiliary data, ancillary data, closed captions, and timecode.
- How to freeze video data.
- How to set up error logging and alarms.
- How to operate the instrument remotely.
- How to navigate instrument menus.
- How to operate the instrument front panel.

Where to Find More Information

This product is shipped with a Product Documentation CD that contains various user documents for all users and reference information for system integrators. The following table shows you where you can find this and more information about your product. You can always find the most updated documentation and software for your product on the Tektronix Web site at www.tektronix.com/downloads.

Table i: Product documentation

To read about	Tektronix part number	Use these documents
Installation and safety	071-2887-XX	Installation and Safety Instructions Provides installation, safety, general specifications, and compliance information. This is a printed manual and is also available on the Product Documentation CD and the Web at www.tektronix.com/manuals.
Instrument operation	077-0531-XX	User Manual (this manual) In-depth descriptions of instrument operation. Available on the Product Documentation CD and the Web at www.tektronix.com/manuals.
Content-sensitive help topics	NA	Online Help Detailed instrument operation and UI help is available in your instrument by pressing the HELP button on the front panel of the instrument.

Table i: Product documentation (cont.)

To read about	Tektronix part number	Use these documents
Specifications and procedures for checking instrument performance	077-0533-XX	Specifications and Performance Verification Technical Reference Physical, electrical, and environmental specifications; functional checks and performance verification procedures. Available on the Product Documentation CD and the Web at www.tektronix.com/manuals.
System integration information	077-0548-XX	System Integration Technical Reference Detailed information about installing the instrument into a system. Available on the Product Documentation CD and the Web at www.tektronix.com/manuals.
SNMP commands	077-0261-XX	WFM and WVR Series Management Information Base (MIB) Programmer Manual SNMP command reference for remotely controlling the instrument. Available on the Product Documentation CD and the Web at www.tektronix.com/manuals.
Information about servicing the instrument	077-0550-XX	Service Manual Detailed information about how to service the instrument at the module level. Available on the Web at www.tektronix.com/manuals.

Conventions Used in This Manual

The following icon is used throughout this manual:

Sequence step or item

Getting Started

Your instrument shipped with a CD containing various user documents and a printed manual with power-on, installation, and accessories information. That manual is also available online at www.tektronix.com/manuals. This User manual contains information about operating your instrument.

This chapter will help you set up and begin to use the instrument. It is divided into the following four sections:

- **Key Features** describes your instrument and provides a list of and key features.
- **Options** tells you where to go for a list of available options.
- **Network Installation** shows you how to set up your instrument on an Ethernet network.
- **Incoming Inspection** provides a procedure for verifying the basic operation and functionality of your instrument.

Key Features

The WFM5200 Waveform Monitor is a portable, short-depth baseband monitor that provides comprehensive video and embedded audio features across 3 Gb/s, SD, and HD signal formats. This instrument provides an ideal solution for basic video and audio (with Option AUD) monitoring needs with an integrated high-brightness, low-power consumption LED backlit display in a convenient 3RU, half-rack, short-depth form factor, suitable for space-constrained environments. This versatile instrument can accept power from a 12 V DC source, a battery, or a 100-240 V AC converter.

The following key features make this instrument an easy to use, flexible, and effective tool.

Item	Description
Flexible tile displays: Full and Quad Tile	**Quad Tile (4-Tile)**: View four measurement displays at once, one in each tile. In Quad Tile mode, the high-resolution XGA display provides four concurrent views of a monitored signal (with a maximum of two trace displays at once). The instrument also provides the flexibility to configure each of the four display tiles independently, enabling you to quickly check the integrity of a signal. **Full**: View the active display full screen.
TandemVu®	Patented display allows you to overlay the Waveform and Vector or Waveform and Lightning displays, plus Picture Thumbnail, in a single, full-tile display.

Item	Description
Multi-Input Display	The Multi-Input Display mode allows you to simultaneously view up to four SDI inputs of the same format. The feature is available in Waveform, Vector, Lightning, Diamond, Split Diamond, Arrowhead, and Spearhead displays. If you are monitoring a 2xHD Level B 3 Gb/s signal, you can select to view the streams of that signal individually.
Presets	Customizable presets allow you to quickly save and recall commonly used configurations.
Digital support	Support for digital applications.
Fully digital processing	Fully Digital Processing allows for accurate, repeatable, drift-free operation that surpasses traditional analog designs.
Waveform display	Traditional waveform displays allow signals to be overlaid or paraded. This display type allows you to use the Multi-Input Display feature.
Vector display	Vector display with Composite and Component Compass Rose Graticules, and gain, sweep, and magnification controls. Traditional and Lightning Vector displays are available. The latter visualizes both luma and chroma amplitudes, and quantifies inter-channel timing. This display type allows you to use the Multi-Input Display feature.
Luma qualified vector display	Vector display that is gated by a specified luminance range. Each vector tile may have a different luminance range specified. This display type allows you to use the Multi-Input Display feature.
Infinite Persistence	All trace displays can also be set, tile by tile, to Infinite Persistence. This mode traces waveforms over time on the same display, providing a visual history of the trace.
Gamut monitoring	Arrowhead, Spearhead, Diamond, and Split Diamond displays offer user-selectable gamut thresholds so that you can set monitoring limits appropriate to a specific operation. Gamut monitoring is fully integrated with the alarm logging and reporting capabilities. This display type allows you to use the Multi-Input Display feature.
LTC waveform display	Longitudinal Time Code (LTC) is monitored in a frame rate display to allow observation of amplitude and noise, and verify LTC is locked to the video.
External Reference Waveform display	The External Reference waveform display check the external reference signal integrity, including its shape and amplitude. This display is independent of the input video signal.
Audio monitoring (Option AUD)	Surround Sound display of audio signals and phase relationships of normal channel pairs.
	Lissajous display lets you monitor a user-specified pairing of channel inputs.
	Support and options for viewing and monitoring both levels of normal channel pairs for embedded audio signals.
	Support for loudness measurement, audio control packet coding, and many popular audio scales, including BBC scales.

Item	Description
Auxiliary data monitoring	Support for monitoring auxiliary data including data conforming to ARIB standards and CEA608, CEA708, AFD, and CGMS-A.
Timing display	A Tektronix proprietary display that simplifies measuring the timing difference between two signals. Using the Timing display enables you to easily compare and correct the timing between two signals.
Closed Captioning support	Support for simultaneous decode and display in multiple languages of CC standards (CEA 608 (VBI), CEA 608 (ANC), CEA (608/708), CEA 708, TeletextB (VBI), TeletextB OP47 SDP (ANC), and TeletextB OP47 Multi (ANC)) with caption text and V-chip information overlaid on the picture (monitor mode). There are also settings for missing or incorrectly inserted closed captioning.
Picture area	Support for standard and custom Safe Graticules for Picture displays that look for incorrect placements of graphics, logos, Black events, and Frozen events. Two Safe Area graticules and Safe Title graticules are supported.
Status screens	Status screens provide content status at a glance.
Error tracking	Configurable alarms and error logging.
Remote control	Full remote control for complete installation flexibility.
Data List display	Examines the contents of all digital formats, structures, and transports and displays the data without any interpolation.
Ancillary data inspector	Allows you to monitor all ancillary data present in a signal.

Options

Your instrument may have been ordered with one or more options.

Instrument Options

- **Option 3G**: Support for 3G-SDI (Level A and Level B) signal formats.
- **Option GEN**: Multi-rate color bar and pathological signal generation provides engineers with a simple signal source for quick signal path verification during system and/or equipment setup and troubleshooting.
- **Option AUD**: 16-channel embedded AES/EBU audio simultaneous monitoring support with Multichannel Surround Sound [1] display and flexible Lissajous display.
- **Option LOUD** (requires Option AUD): Audio Loudness monitoring to ITU-R BS.1770-2/1771, EBU R 128, and ATSC A/85 recommendations.
- **Option CAM**: 4-SDI channel simultaneous monitoring (SIM) allows for quick and easy setup of multiple cameras during content acquisition for OB van and production studio applications. SIM function allows two channel monitoring simultaneously with SyncVu™.

- **Option PROD**: Advanced color gamut displays (Spearhead and Luma Qualified Vector displays) work in conjunction with the Diamond gamut display to provide the most comprehensive color gamut monitoring tool for precise color gamut adjustments.
- **Option DATA**: Comprehensive data monitoring helps to quickly resolve difficult content quality and reliability issues through closed captioning, subtitles, AFD decode/display and full ANC data support.

1 Audio Surround Sound Display licensed from Radio Technische Werksütten GmbH and Co. KG (RTW).

You can check which options are on this instrument after it is powered on by performing the following steps:

1. Press the **CONFIG** button on the front panel.
2. Use the General knob to navigate to **Utilities**.
3. Press the right arrow button to navigate to the **Utilities** submenu and select **View Instrument Options**. The menu box on the right side of the display shows the installed options.

Service Options

You can add any or all of the following service options to any instrument. (See Table 1.)

Table 1: Service options

Option	Description
Option CA1	Adds a single calibration or coverage for the first designated calibration interval, whichever comes first.
Option C3	Adds 3 years of Calibration Service.
Option C5	Adds 5 years of Calibration Service.
Option D1	Adds a Calibration Data Report.
Option D3	Adds 3 years of Calibration Data Report (when ordered with option C3).
Option D5	Adds 5 years of Calibration Data Report (when ordered with option C5).
Option R3	Adds 3 years of Repair Service (including the period under warranty).
Option R5	Adds 5 years of Repair Service (including period under warranty).

Connecting Power

AC Adapter

The instrument operates from an external AC adapter with a line frequency of 50 or 60 Hz, over the range of 100-240 Volts, without the need for configuration, except the power cord. The typical power draw is 27 Watts. Refer to the *WFM5200 Specifications and Performance Verification Technical Reference* on the Product Documentation CD for additional information on power and environmental requirements.

Battery

This instrument can be powered by a 12 V DC input or by a 14.4 V standard camera battery. If you are using a battery with this instrument, read the following battery safety notices. This instrument was designed to be used with an Anton Bauer battery. It can also be used with a Sony or IDX V-mount style battery.

CAUTION. *Before using the Anton Bauer Power Tap feature, refer to the product information included with the battery. If that information is not available, contact the battery manufacturer for information.*

WARNING. *Fire can cause personal injury and/or property damage. To prevent risk of fire, when using a 12 V DC source other than the provided AC adapter, make sure that it has a suitable current limiting device (such as a fuse).*

WARNING. *Risk of personal injury and/or property damage from falling instrument. Batteries from various manufacturers may vary in shape and weight. When a battery is installed, it is possible that it will make the unit too heavy in the back, causing the instrument to tip backward.*

Power-On

1. Connect the supplied power cord to the rear-panel power connector. If you are using a battery, connect the battery as explained in the installation instructions that come with the battery.
2. Press the power button on the instrument front-panel and the instrument will turn on.

NOTE. *The Standby button on the front-panel does not disconnect mains power. Only the power cord at the rear of the product can disconnect mains power. Make sure that the power cord is accessible when the product is operating.*

Power-Off

1. Press the power button on the instrument front-panel to turn the instrument off.
2. To remove power completely, disconnect the power cord from the rear-panel of the instrument.

Network Installation

After your instrument is physically installed, you might want to connect it directly to a PC and a network. The following information can help you do that.

See the *WFM5200 Installation and Safety Instructions* that shipped with your instrument for basic installation instructions.

If you are installing this instrument into a system, see the *WFM5200 System Integration Technical Reference* for installation instructions.

Connecting Directly to a PC

The following procedure will help you connect your instrument to a PC:

1. Connect the instrument directly to a PC with an Ethernet cable. The instrument has an auto-crossover feature. You can also use a HUB. (See Figure 1.)
2. Set up the instrument as described in the following procedures, choosing Manual IP mode to set the IP address manually. Be sure to set an address that is compatible with the setting of your PC.
3. If you are using an SNMP setup, use the SNMP setup procedure.

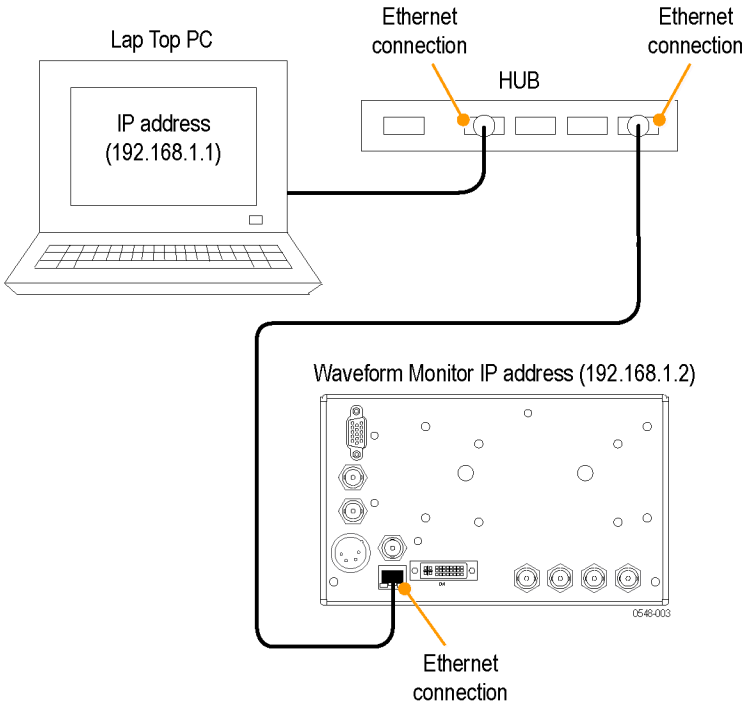


Figure 1: Connecting the instrument to a PC

Connecting to a Network

The following topics cover configuring the IP settings so that you can use your instrument over a network, and configuring SNMP, which is required if you are using commands to control the instrument.

Connection and IP settings. To allow network access to the instrument, you must set the IP address. Network addresses can be assigned either automatically (DHCP) or manually. If your network does not use DHCP, you will have to manually enter the address for the instrument. To get an address, talk to your LAN administrator.

To connect your instrument to a network and access it with a remote PC, do the following:

1. Press **CONFIG** to display the Configuration menu.
2. Select **Network Settings** > **Web Enable**. Press **SEL** to select **On**.
3. Set the IP Config Mode to Manual or DHCP, depending on your network setup.
4. If you cannot use DHCP, set the subnet mask and gateway address network parameters in this menu; see your LAN administrator for required values. (Be sure to use compatible addresses between the PC and the instrument.) You can also set the instrument name and view the MAC Address.
5. Press **CONFIG** to close the Configuration menu.

SNMP Setup

If you intend to use SNMP commands to control the instrument (SNMP control is primarily intended for access through automation systems), you must set up SNMP parameters.

NOTE. *The WFM5200 Waveform Monitor wfm_mon.mib and wfm5200.mib contain SNMP OIDs and can be downloaded from the instrument Web page. You can also download a printable version of a MIB manual from www.tektronix.com/manuals.*

The procedure to set SNMP settings is similar to the procedure for IP settings. (See page 7, *Connection and IP settings*.)

This table shows the parameters that you can set.

Setting	Description
SNMP Enable	This entry in the Network Settings part of the Configuration menu allows you to turn on or off the remote access through SNMP.
SNMP Trap Enable	This menu entry allows you to turn on or off the traps that are sent out through SNMP.
SNMP Trap Address	This menu entry allows you to set IP addresses to which SNMP traps are sent through SNMP. Traps can be sent to up to four addresses when error conditions are detected. ***NOTE.*** *A value of all zeroes for the address will disable that trap output.*

Private Community String	This menu entry allows you to set the Private Community string. This string is effectively a password. Without this string, SNMP commands cannot change values in the instrument. ***NOTE.*** *The Private String is necessary for SNMP access to write changes into the instrument.*
Public Community String	This menu entry allows you to set the Public Community string. This string is effectively a password. Without this string, SNMP commands cannot read values from the instrument. ***NOTE.*** *The Public String is necessary for SNMP access to read values from the instrument.*

Incoming Inspection

The incoming inspection procedures are optional procedures to check the functionality of your instrument. These procedures require no equipment other than an external monitor or display. For a more robust inspection, see the performance verification procedures in the *WFM5200 Specifications and Performance Verification Technical Reference* that is included on the Product Documentation CD that shipped with your instrument.

Basic Turn On and Self Test

You can perform the following test with or without the external monitor. Using the external monitor allows you to check that the DVI connector on the rear panel is working properly:

1. Connect a monitor to the **DVI** connector on the rear panel of the instrument. This connector is a DVI-I connector with socket contacts. The output supports DVI monitors directly and analog PC (RGB) monitors using a DVI-I to VGA adapter.
2. Connect the AC line cord to the rear of the instrument and to a 100 to 240 VAC source.
3. Press the Power button on the front panel to turn the instrument on. It is located on the bottom left corner of the front panel.
4. After about 30 seconds, the power-on diagnostic page should appear on the screen.
5. Verify that all self tests pass. Any failures are shown in red. The results of the power-on diagnostics are erased from the screen, but you can view the results by selecting **CONFIG > Utilities > View Diagnostics Log > SEL** or by viewing them on the instrument Web page.
6. After the diagnostics are finished, the instrument state is restored. When the progress indicator in the status bar is finished, the instrument has finished initializing.
7. If it is still open, exit the Diagnostics Log.

Front Panel Test

1. Press and hold the **PRESET** button.
2. Use the **GENERAL** knob to navigate to **Recall Preset**.
3. Press the right and down arrow keys to navigate to **Recall Factory Preset**, and then press the **SEL** button.
4. Press the **Display Select / Thumbnail** button to change the active tile. Check that the active tile has a blue border.
5. Press and hold the **Display Select / Thumbnail** button to change the active tile from 4-tile view to full-tile view. Press and hold the button again to change it back.

6. Press the **MAIN** button, highlight **Tile Display**, and then press the **SEL** button to change the view to full tile.

7. Press each of the front panel buttons, one at a time, except for the power button and the **HELP** button.

   Each button should flash as you press it. When you press the **PRESET** button, all of the measurement buttons along the bottom the front-panel should light up and stay lit until you press the **PRESET** button again.

Fan Test

You should be able to hear the fans and feel air coming out of the back of the instrument. At low temperatures, the fans will turn slowly and be very quiet.

Getting Acquainted with Your Instrument

Front-Panel Controls

NOTE. *Some of the controls that are covered in this section are option-dependent. For a list of the options that are installed on your instrument, press the* ***CONFIG*** *button. In the configuration menu, select the* ***Utilities*** *submenu. The* ***View Instrument Options*** *entry lists the options installed on your instrument.*

Three Levels of Control

You control the instrument on three levels:

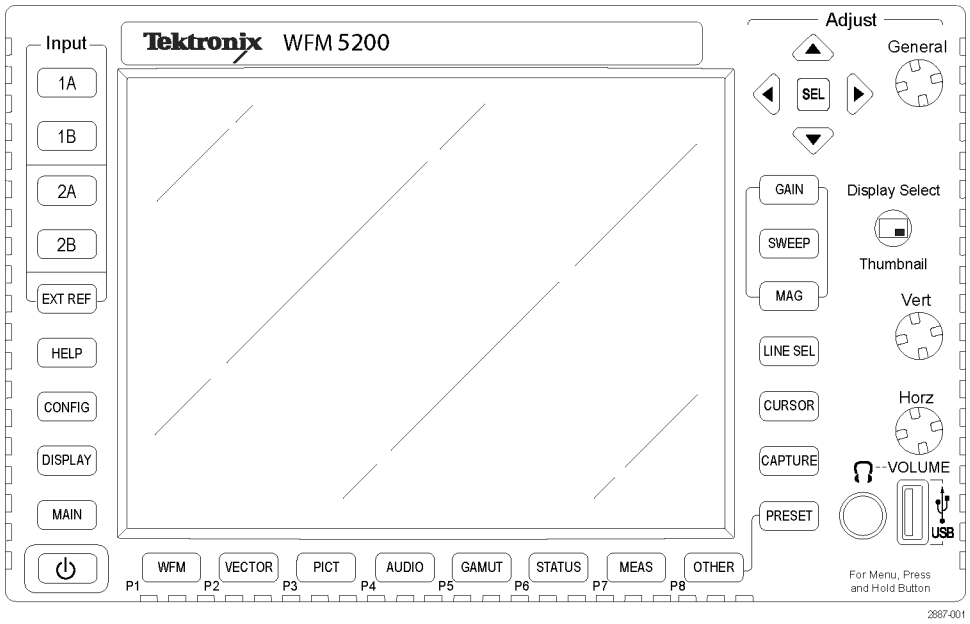
- **Frequently changed settings.** The front-panel buttons control the most commonly changed parameters, such as which measurement appears in each tile. The knobs are used to adjust levels and make selections.
- **Tile-specific settings.** Pop-up menus control parameters that are specific to the tile in which they are displayed. The pop-up menus control less frequently changed parameters such as the waveform display mode (for example, changing the waveform display mode from RGB to YPbPr). To display a pop-up menu, press and hold the desired display or function button for about a second.
- **Instrument-wide settings.** The parameters in the Configuration menu are instrument-wide settings. The configuration menu controls settings that are changed only occasionally, such as changing waveform color or setting the network address.

Scope of Controls

Some controls are global and affect all tiles, while other controls only affect the active tile. Generally, if a control is configured by front-panel buttons or by a pop-up menu, it is tile-specific. (Exceptions are the Input buttons and all audio features, both of which are global.) If a control is configured by the **CONFIG** menu, selections are usually global.

Layout and Usage

The primary front panel elements shown below are described in the table that follows. The Usage procedure column in the table refers you to a procedure in this manual that explains how to use the element. If there is no page reference, the information given explains the basic function of the element.



Control element or group	Usage procedures
Display select / Thumbnail button	Press this button to choose which of the four tiles to activate. Press and hold to view a display full-screen. You can also change the function of the button to Thumbnail in the **MAIN** button menu.
Measurement buttons	How to select a display using the measurement buttons (See page 24.)
Gain, Sweep, and Mag buttons	How to use Gain, Sweep, and Magnification (See page 78.)
Preset buttons	How to use Presets (See page 82.)
Input Selection buttons	*Selecting Signal Inputs* (See page 19.)
Line Select button	*Setting Line Select Mode* (See page 81.)
EXT REF button	*External Reference* (See Figure 8.) *Timing a Studio* (See page 129.)
Capture button	*Freezing the Display* (See page 80, *Capture*.)
Help button	*Online Help* (See page 14, *To Navigate Online Help*.)
Cursor button	*Measuring Waveforms with Cursors* (See Figure 37.)

Control element or group	Usage procedures
Configuration button	Use to set parameters, view instrument options, upgrade software, and perform many other tasks.
Up/Down/Left/Right Arrow keys and SEL button	Use to navigate menus and select parameters.
General knob	Use to navigate menus and adjust parameters.
Vertical and Horizontal knobs	Use to position waveforms when displayed in tiles or full-screen. When the Audio tile is active, use the Horizontal knob to adjust the headphone volume.
Power button	Press to turn the instrument on or off. Note that this button does not remove power from the mains.
Display button	Access to picture brightness, LCD backlight intensity, dim display, Infinite Persistence mode, and save display to USB function.
Main button	Access to Tile select function, 4-tile and full-screen display modes, Multi-Input Display mode, Multi-Button function, Overlay (TandemVu®) mode, and USB status.
Other button	Access to the LTC Display, External Reference Waveform Display, and Diagnostics Monitor. (See page 47, *LTC Display*.)(See page 48, *External Reference Waveform Display*.)

Instrument Online Help

When you press the **HELP** button on the front panel of your instrument, the instrument online help is accessed. Use the instrument online help when you have questions about buttons, features, operations, or anything else related to your instrument. It is:

- Context-sensitive. The topic displayed depends on what is displayed in the active tile when the online help is selected or what control is operated after help is selected.
- Navigable. The Contents and Topic Selector panes, with links within the topics, provide access to topics. (See Figure 2 on page 14.)

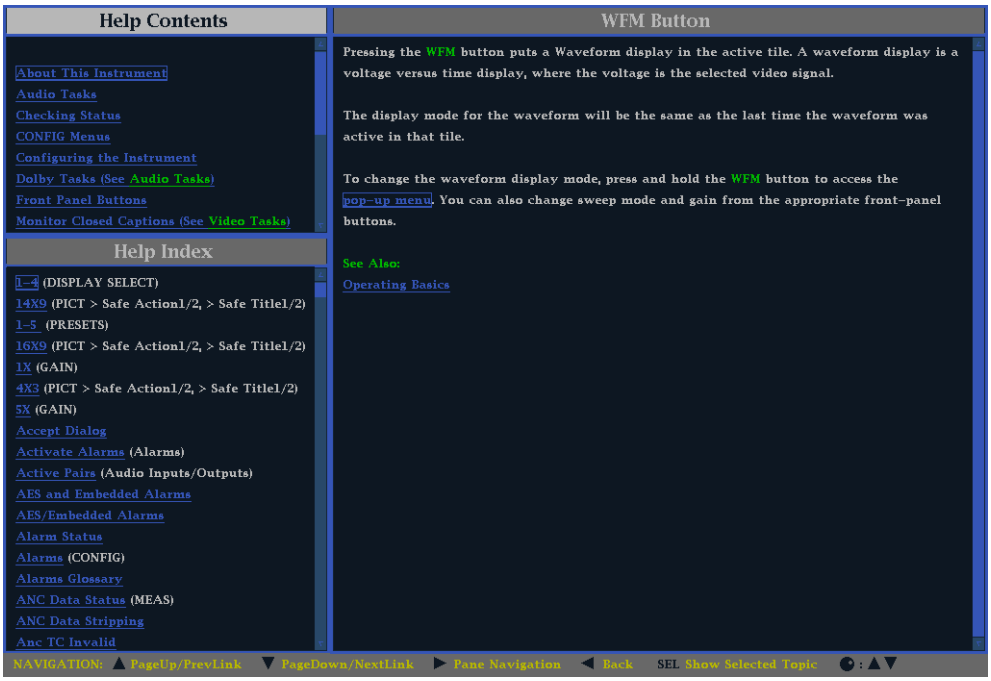

Help Contents
About This Instrument
Audio Tasks
Checking Status
CONFIG Menus
Configuring the Instrument
Dolby Tasks (See Audio Tasks)
Front Panel Buttons
Monitor Closed Captions (See Video Tasks)
Help Index
1–4 (DISPLAY SELECT)
14X9 (PICT > Safe Action1/2, > Safe Title1/2)
1–5 (PRESETS)
16X9 (PICT > Safe Action1/2, > Safe Title1/2)
1X (GAIN)
4X3 (PICT > Safe Action1/2, > Safe Title1/2)
5X (GAIN)
Accept Dialog
Activate Alarms (Alarms)
Active Pairs (Audio Inputs/Outputs)
AES and Embedded Alarms
AES/Embedded Alarms
Alarm Status
Alarms (CONFIG)
Alarms Glossary
ANC Data Status (MEAS)
ANC Data Stripping
Anc TC Invalid
WFM Button
Pressing the WFM button puts a Waveform display in the active tile. A waveform display is a voltage versus time display, where the voltage is the selected video signal.
The display mode for the waveform will be the same as the last time the waveform was active in that tile.
To change the waveform display mode, press and hold the WFM button to access the pop-up menu. You can also change sweep mode and gain from the appropriate front-panel buttons.
See Also:
Operating Basics
NAVIGATION: ▲ PageUp/PrevLink ▼ PageDown/NextLink ▶ Pane Navigation ◀ Back SEL Show Selected Topic

Figure 2: Instrument online help

To Navigate Online Help

1. Press the **HELP** button.
2. Press the right arrow key to navigate to the one of the three panes: **Help Contents**, **Help Index**, or the right-side pane that contains the topic content related to the front panel button you press while help is activated or the links in the help files and menus you use.
3. Use the General knob or the up/down arrow keys to highlight an entry in the Contents (entries never change) or the Index, or to highlight a link in the topic pane.
4. Press the **SEL** button to select the highlighted item.
5. Press the **HELP** button again to exit online help.

Instrument Display

This instrument uses Quad Tile, which is a flexible, four-tiled display that can show four tiles at one time or a single, full-screen sized tile. The instrument also provides the flexibility to configure each of the four display tiles independently, enabling you to quickly check the integrity of a signal.

Display Select Button

This button allows you to select one of four tiles while in 4-tile mode and change from 4-tile to full-screen mode and back again. To move between tiles, press the **Display Select** button. The active tile is outlined in blue. The tile numbers and their associated quadrants are shown here. You can see that tile four is active because of its blue border. (See Figure 3.)

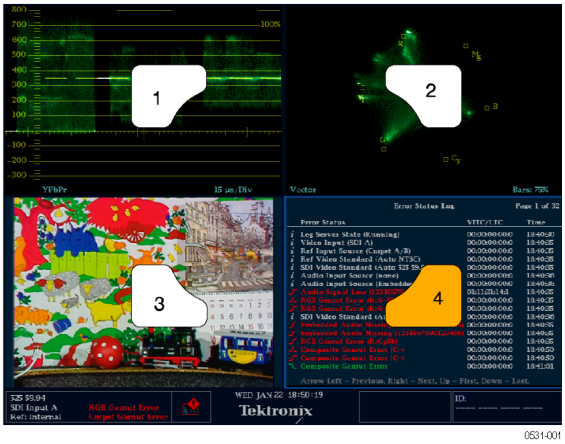


Figure 3: Display quadrants and related tile numbers

You can change from 4-tile to full-screen mode two ways: press and hold the **Display Select** button until the view changes; or press the **MAIN** button, select **Tile Display** from the pop-up menu, and then press the **SEL** button to select **FULL**. (See Figure 4.)

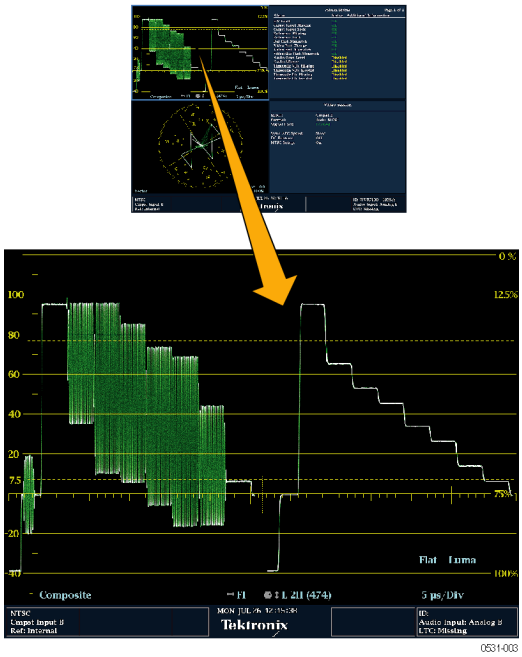


Figure 4: Changing from 4-tile to full-tile view

Status Bar

The Status Bar is located on the bottom of the instrument display and shows instrument status, the type of signal being monitored, any alarms associated with that signal, and other information. (See Figure 5.)

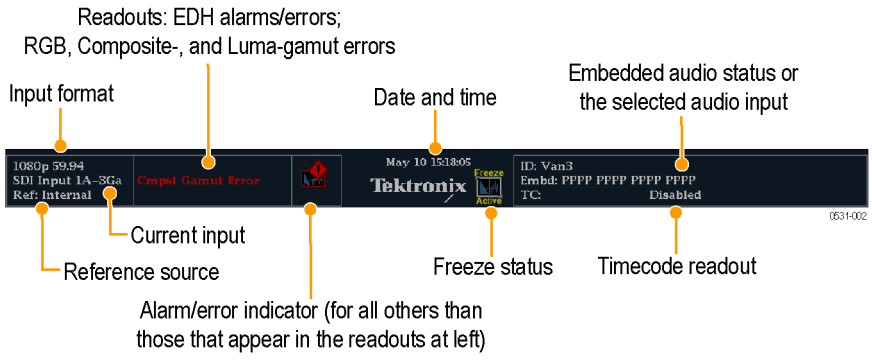


Figure 5: Status bar

Status display element	Description
Input Format	Text indicating the format of the signal on the selected input or whether signal is missing or unlocked.
EDH Error	A one-line area that is visible if EDH errors are present.
RGB Gamut Error	A one-line area that is visible if RGB gamut errors are present. ***NOTE.*** *Because RGB and Composite Gamut messages appear on the same line in the display, if both RGB and Composite Gamut errors are present at the same time, the message "RGB and Cmpst Gamut" will appear.*
Composite Gamut Error	A one-line area that is visible if Composite gamut (Arrowhead) errors are present. ***NOTE.*** *Because RGB and Composite Gamut messages appear on the same line in the display, if both RGB and Composite Gamut errors are present at the same time, the message "RGB and Cmpst Gamut" will appear.*
Luma Gamut Errors	A one-line area that is visible if Luma errors are present.
Alarm/Error Indicator	An icon visible when alarms of types other than those in the four readouts just listed occur.
Date and Time	Readout of the date and time (set in **CONFIG** > **Utilities**).
Instrument Name	Name assigned to the instrument in the **CONFIG** > **Utilities** menu.
Audio Status	An up to 32-character string indicating the selected audio input or the embedded audio channel status, when embedded audio is the selected input. In the latter case, each character shows the status of a specific channel: **–** for not present and **p** for present.
Timecode Readout	A readout showing the selected time-code value.
Reference Source	Text indicating the source of the current reference. Possible references are: Ext., Internal. Also indicates format and whether the reference is missing or unlocked.
Current Input	Text indicating the selected input. Some possible inputs are: SDI 1A, SDI 1B, SDI 2A, and SDI 2B. Also indicates if the current input is not in Auto mode or is unlocked.

Status Bar Icons

Display Icons	Description
	Warning - Appears when an error or an alarm that is mapped to the user interface triggers.
	Alarms Muted - Appears when the alarms are muted from the **STATUS** pop-up menu.
	Remote Access - Appears when the instrument is accessed from the network. For example, when sending commands to the instrument from the remote interface.
	Alarms Disabled - This text appears in the Status Bar when Alarms are disabled from the Configuration menu.
	Freeze Active - Appears when the tiles are frozen or captured.
	Battery Low - This icon appears only on instruments using an external battery as a power source. This icon appears when the battery has less than 10 minutes of operating power remaining.
	Camera Tally – Appears when camera tally mode is on. This setting is accessed from the CONFIG > Utilities > Ground Closure Mode menu. This mode used the REMOTE connector and is used to define which input is On-Air (RED) and which input is available to be adjusted (GREEN). When this mode is on, it is also indicated above the Picture display of the selected input. ***NOTE.*** *For REMOTE connector pin descriptions, see the WFM5200 Waveform Monitors Installation and Safety Instructions.*

Rear Panel Specifications

See the *WFM5200 Waveform Monitor Installation and Safety Instructions* that shipped with your instrument for rear-panel specifications. It is also available in electronic format on the Product Documentation CD and on the Tektronix Web site at www.tektronix.com/manuals.

Signal Inputs and Outputs

After you have connected a signal source or a cable for a signal output to the rear panel of your instrument, there are several menus to use to set up your signal:

- **Config > SDI Input**: select how SDI inputs are displayed. The instrument can automatically detect the input format, sample structure, and transport type (or you can specify these manually). You can also choose to not display the EAV, SAV, and ANC data; set chroma alignment; select HD colorimetry; and set the dual link threshold.
- Input **1A/1B** and Input **2A/2B**: select a button (press and hold for pop-up menu) to view the complete signal or selected streams of a 2xHD 3 Gb/s SDI signal. Input selections that appear depend on installed options and display settings. Possible menu options include Input 1A, 1A.1, 1A.2, 1A.1+2, 1B, 1B.1, 1B.2, and 1B.1+2.

  If you have two separate signals connected to two different inputs on the rear panel of the instrument, you can control which channel is displayed by pressing the associated input button on the front panel of the instrument. When the input button is lit, the channel is displayed. When the button is not lit, that channel will not be displayed.
- **Config > External Reference**: select how the external reference signal is displayed. The instrument can automatically detect the input format or you can specify which format you want detected.
- **Config > Outputs**: select the signal type, format, and pattern to output. Some signals require Option GEN and Option 3G.
- **Config > Audio Inputs/Outputs**: select the embedded audio signal channel, format, and mapping. Requires Option AUD.

SDI Signals

Connect one or more 3G-SDI, HD-SDI, or SD-SDI signals to the SDI inputs on the rear panel of the instrument. After that is finished, use the front panel buttons to set the parameters for monitoring the signals, such as thresholds, alarms monitored, and audio source. (See Figure 6.)

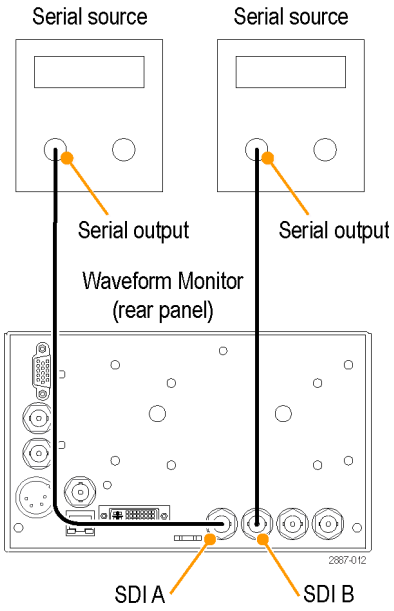


Figure 6: Two SDI signal connection

Dual Link Signals

The inputs for dual link signals are the same as for SDI signals. Dual Link monitoring allows you to set up your instrument to monitor higher resolution signals than can be monitored using the traditional single link input. Dual link signals are combined in the instrument and then shown as a single signal on a waveform or other display.

When you set input formats, sample structure, and transport type to Auto in the **CONFIG > SDI Input** menu, your instrument automatically configures for Dual Link signals if SMPTE352M (VPID) is present. If SMPTE352M (VPID) is not present, you must manually set up sample structure and transport. View the Video Session Display (**STATUS>Display Type>Video Session**) to verify proper configuration.

Your instrument automatically detects the format on signals with SMPTE352M (VPID) while operating on Dual Link signals. You can then view combined Link A, Link B, and Alpha Channel information, which can help with the identification of correct content. Alpha Channel information is visible, if present. The following illustration is an example of how the signal components would appear. (See Figure 7.)

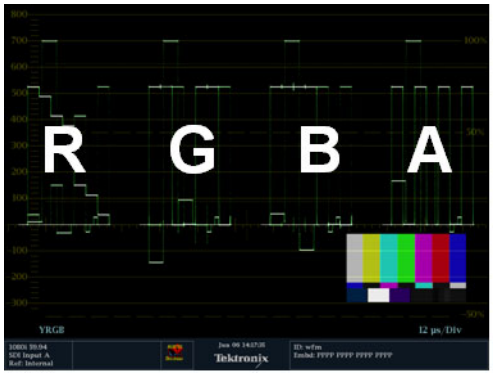


Figure 7: Dual Link information placement in waveform display

Reference Loop

Reference signals can be Black Burst or Tri-level sync. After you connect the appropriate reference signal, press the **EXT REF** button the on the front panel of the instrument. You can also choose which format to lock to by pressing the **CONFIG** button and selecting **External Ref**. The default setting is Auto.

The reference input is passive and requires external termination. If you install this instrument to monitor an operating link, the destination receiver and the connecting cable serve as the termination. This monitoring connection checks the performance of the entire path. The return loss of the instrument is sufficiently high that, in most cases, the destination receiver sets the system return loss.

In cases where this instrument is placed at the end of a link, you must install a BNC termination on one side of the loop-through external reference connector. The termination must be 75 Ω and DC coupled. (See Figure 8.)

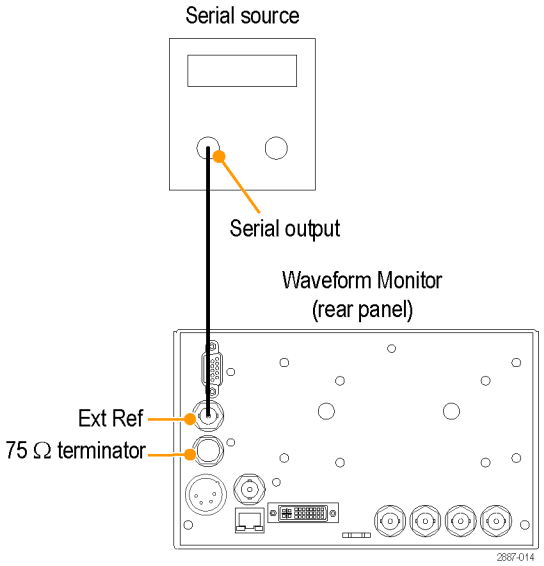


Figure 8: External reference signal connection

Signal Generation

If this instrument has Option GEN installed, it can generate SD-SDI and HD-SDI signals. With Option 3G and Option GEN installed, it can also generate a 3 Gb/s test signal. (See Figure 9.)

Three types of signals can be generated in SD (525,625), HD (720, 1080), and 3G Level A and Level B formats:

- 75% bars
- 100% bars
- Pathological

For more information about these signals, see the appropriate SMPTE standard.

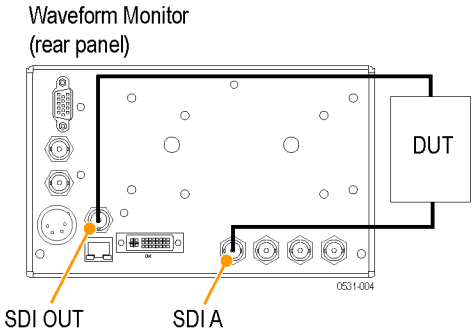


Figure 9: Signal generation connection

After you have connected the signals, press the **CONFIG** button on the front panel of the instrument and navigate to the **Outputs** submenu. From this submenu, select the test signal pattern, level, and format you want to generate.

Display Information

This instrument can support the following displays:

NOTE. *Some displays require a specific option to be installed. For example, the Audio display is not accessible unless you have Option AUD. (See page 3, Options.)*

- Waveform: YPbPr, YRGB, RGB, SDI → Composite or XYZ
- Vector: Normal, SDI → Composite, Lightning, Luma Qualified Vector (On or Off)
- Gamut: Arrowhead, Spearhead, Diamond, Split Diamond
- Measure: Timing, Datalist, Bowtie, ANC Data
- Status: Error Log, Alarm Status, Video Session, Audio Session, Dolby Status, Audio Loudness, Audio Control, Channel Status, Auxiliary Data Status
- Audio: Phase, Surround, Loudness
- Picture: Picture frame (on/off) and various closed caption and safe area graticules

To Select a Display

Push a front panel button corresponding to the display that you want to view and one of the following selected displays will appear:

- **WFM**: display of video waveform
- **VECTOR**: display of vector and lightning plots of color signals
- **PICT**: display of the picture generated by the video signal
- **AUDIO**: display of levels (meters), phase (plot), and surround sound for monitoring audio signals
- **GAMUT**: display of one of four views for checking the gamut of an SDI signal
- **STATUS**: display of extensive views of signal status
- **MEAS**: display of various measurements, including timing, audio video delay, ANC data, and Data List
- **OTHER**: display of the Longitudinal Time Code (LTC), External Reference Waveform display, and Diagnostic Monitor

Pop-Up Menus

All pop-up menus are displayed by pressing and holding the specified display button for three seconds. To hide a pop-up menu, press the specified button again. Pop-up menus appear in the active tile and, in general, control only settings specific that tile. A pop-up menu will not appear if it is not appropriate for the current instrument setting (for example, trying to display the Gamut menu when viewing a composite input signal).

To Set Display Parameters

Use the pop-up menus to set up the measurements that you display.

1. Select a tile by pressing the **Display Select** button.
2. Press and hold a display button and the display and the pop-up menu for that display appears.

NOTE. *The selections in a pop-up menu can change depending on settings.*

3. Use the right and left keys to move between menu panels. The instrument surrounds the panel selected with a blue border.
4. Use the up and down arrow keys to select parameters in a menu. (See Figure 10.)

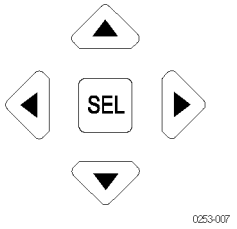


Figure 10: Navigate menus using the arrow keys and select button

5. Navigate through the menu and make your selections.

Multi-Input Display Mode

The Multi-Input Display mode is available when Option CAM is installed. This mode supports the simultaneous display of up to four SDI inputs of the same format. You can choose to view a specific stream of a multi-stream signal (such as a 2xHD Level B 3 Gb/s signal) or both streams together. This mode is only available for use in the **WFM**, **GAMUT**, and **VECTOR** displays. SIM mode allows for two SDI input channels to be displayed simultaneously.

To Turn On the Multi-Input Display

Enabling the Multi-Input display mode is a two step process. The Multi-Input menu option is only available in the **WFM**, **GAMUT**, and **VECTOR** pop-up menus when the feature is enabled from the **MAIN** button menu and the display is viewed full-screen. To enable this feature:

1. Press and hold the **MAIN** button.
2. Navigate to **Multi-Input Mode**.
3. Press the **SEL** button to highlight **Enable**.
4. Press the **MAIN** button to dismiss the menu.

The Multi-Input display mode is now enabled. The next step is to turn on the feature in a given trace by doing the following:

1. Select the tile in which you want to view a multi-input display.
2. Press and hold the **Display Select** button to view either a WFM, Vector, or Gamut display full-screen.
3. Press and hold the **WFM**, **VECTOR**, or **GAMUT** button to view the pop-up menu for that display.
4. From the pop-up menu, select **On** for **Multi-Input Display**.

The Multi-Input display mode will now be active.

NOTE. *The Multi-Input display may be selected for each tile individually, but it will only be active when the tile is displayed full-screen.*

You can configure another tile without multi-input mode so that you can switch quickly between Multi-Input and normal input modes by switching tiles. In four-tile display mode, all tiles will display the currently selected input.

To Select Inputs to View

If you have two separate signals connected to two different inputs on the rear panel of the instruments, you can control which channel is displayed by pressing the associated Input button on the front panel of the instrument. When the input button is lit, the channel is displayed. When the button is not lit, that channel will not be displayed.

Selecting an input to be displayed does not change the inputs being monitored. For example, if you have two SDI signals connected, one to Input 1A and the other to Input 1B, pressing the 1B button so that it is not lit will eliminate the channel from a trace display, but not stop the channel from being monitored for status or alarms.

To Select Streams to View

You can select to view one or both streams simultaneously of a 2xHD Level B 3 Gb/s SDI signal from an input button pop-up menu. When you press and hold an input button, the pop-up menu that appears allows you to select to view stream 1, stream 2, or both streams of that signal.

The following Input 1A button pop-up menu options appear when a trace display is set to Multi-Input display mode in full-screen. Pressing the 1B, 2A, or 2B input buttons will give you the same menu options as follows, but with different labels.

NOTE. *You can customize the input labels. (See page 29, To Customize Input Labels.)*

- **Input 1A**: shows the entire stream when a signal stream signal is used or both streams overlayed when a 2xHD Level B 3 Gb/s signal is used.
- **Input 1A.1**: shows only the first stream of the two streams of a 2xHD Level B 3 Gb/s signal in the input in the trace display.
- **Input 1A.2**: shows only the second stream of the two streams of a 2xHD Level B 3 Gb/s signal in the input in the trace display.
- **Input 1A.1+2**: shows both of the two streams of a 2xHD Level B 3 Gb/s signal individually. Each trace is labeled in the display as either Input 1A.1 or Input 1A.2 (or a label you have customized) and shows both streams individually in the trace display.

NOTE. *When Multi-Input mode is disabled, only the first three options in the previous list appear in the input button pop-up menu.*

You may select up to eight channels of video from 2xHD video sources, but only the first four are displayed in Multi-Input mode. 2xHD video formats may be used for 3D video content in which the left eye view is typically carried in channel 1 and the right eye in channel 2. The 2xHD formats are defined by SMPTE 425 as an option for 3 Gb/s Level B SDI video. 2xHD formats are available in 720p, 1080i, and 1080p (23.98 - 30 fps).

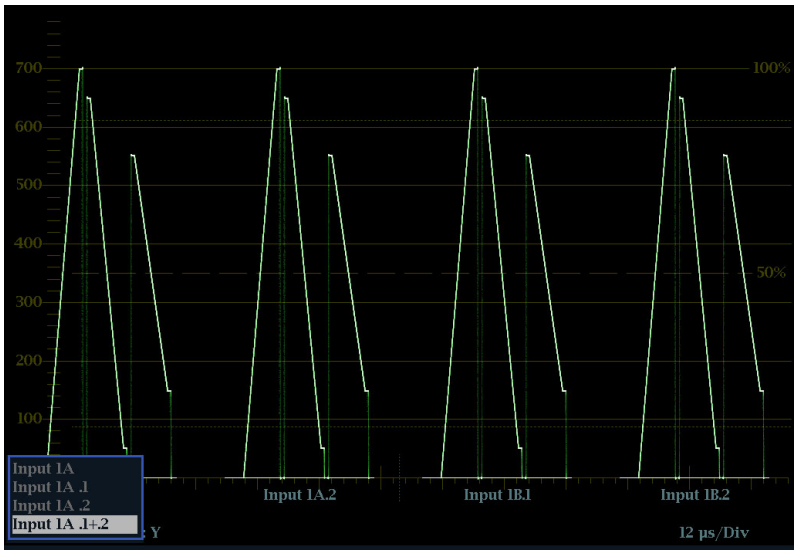


Figure 11: Waveform display in Multi-Input mode showing multiple channels

To Customize Input Labels

You can name the input labels from the **CONFIG** > **Graticules and Readouts** > **Input Labels** menu. Once you are in the **Input Labels** menu, select an input and then press the **SEL** button. A dialog box will appear allowing you to name the input.

Simultaneous Input Monitoring

Your instrument can monitor two separate signals simultaneously when Option CAM is installed. In this mode, the instrument display is divided into two sides, each with two tiles per input. This allows you to conveniently view measurement and status displays from two signals at the same time.

If one or both of the signals being monitored is a 3G signal, they need to be on numerically different inputs or a trace resource limitation will occur. For example, 3G on Input 1A and 3G on Input 2A; or 3G on Input 1B and HD on Input 2A. However, there are no resource constraints for 3G Level B 2X HD 1A.1 and 1A.2 or both monitoring channels being set to the same input (Option 3G is required for 3G-SDI formats).

Connect signals for simultaneous monitoring the same way you would for connecting two SDI signals. (See Figure 6 on page 20.)

SyncVu™

The SyncVu™ feature works with the simultaneous input monitoring (SIM) mode and allows you to configure the settings for two inputs at the same time. (See page 29, *Simultaneous Input Monitoring*.)

To set the instrument to SyncVu™ mode after you are in SIM mode, do the following:

1. Press the **MAIN** button.
2. Select **SyncVu**.
3. Select **Enable**.

How to Change Settings Using SyncVu

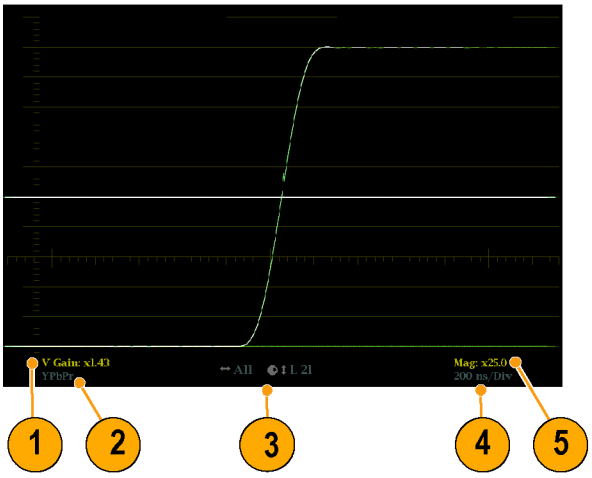
This instrument can display four tiles. When you are viewing two inputs simultaneously in SIM mode, the tiles on the left side of the display show the first input. The tiles on the right side of the display show the second input. The display type in tile 1 for the first input is the same display type shown for the second input in tile 2: Top left to top right and bottom left to bottom right. SyncVu™ allows you to change the settings for the two related tiles at the same time.

For example, if you have a waveform display in tile 1 of input 1A, then tile 2 is the waveform display for the second input. When you adjust the settings for the waveform displayed in tile 1, the settings for the waveform displayed in tile 2 are adjusted simultaneously. Similarly, adjusting settings for tile 2 are applied to tile 1.

Waveform Display

The WFM button displays the Waveform display, which is the voltage versus time display of a signal. You can view the input signal in line or field sweep and choose which SDI signal elements are displayed (RGB, YRGB, or YPbPr). Filters can also be applied to the signal. This instrument will allow you to display the signal from an SDI input as if it were a composite signal and control (from the CONFIG menu) whether EAV, SAV, and ANC data is included in the display.

Elements of the Waveform Display



1. This readout is blank when vertical gain is X1; otherwise, this indicates that V Gain is X5 or variable.
2. This readout lists the currently displayed waveform color-space. Dashes (–) indicate components not displayed.
3. This readout lists the currently selected field and line (when in Line Select mode).
4. This readout lists the current sweep rate for tile.
5. This readout lists the Mag rate if MAG is on.

Waveform Pop-Up Menu and Settings

The Waveform pop-up menu enables you to choose the display style and display mode used in the active tile (SDI inputs only), to select a filter to apply to the input signal, to turn on the Multi-Input display mode, and to center the waveform in the display.

To choose a display mode, select from the following the choices (only available while displaying SDI inputs) in the menu:

- **YPbPr** - Displays the input as Luma (Y) and color difference (Pb, Pr) components.
- **YRGB** - Displays the input as Luma (Y), Red (R), Green (G), and Blue (B) components.
- **RGB** - Displays the input as Red (R), Green (G), and Blue (B) components.
- **SDI** > **Composite** - Displays the SDI input as if it is encoded into composite. The sync and burst in this mode are synthetic and convey no information about signal quality.

When viewing 525-line SDI input as a composite waveform while using line select mode, both burst phases may appear when you would expect to see only one. This is because the line selection in SDI Mode is an odd/even selection, and composite signals are normally viewed with a one-of-four or one-of-eight line selection.

To choose how the signal components are displayed in the active tile, use the Display Style menu setting (SDI inputs only) to select:

- **Parade** style - has all the components shown one beside the other.
- **Overlay** style - has all the components drawn at the same location so that they appear one on top of the other.

The Waveform pop-up menu Filter selection allows you to select filters to be applied to the video. This is useful for isolating a specific characteristic of the input. For example, to measure amplitude, you may want to use a Luma or Low pass filter to remove the high frequency components.

To choose a filter select one of the following filters from the Waveform menu:

- **Flat** - Display with the full available bandwidth.
- **Luma** or **Low Pass** - Display only the low-frequency part of the signal.

To turn on the Multi-Input display mode, select **Multi-Input Display** and press **SEL**. Next, press and hold the **Display Select** button to view the display full-tile and activate the Multi-Input view.

NOTE. *The Multi-Input menu option is only available in the WFM pop-up menu when the feature is enabled from the MAIN button menu.* *(See page 26, Multi-Input Display Mode.)*

To cancel any horizontal or vertical position adjustments and restore the trace to the default position, select **Center Waveform** and press **SEL**. For a tile in WFM mode, this puts the baseline at the zero graticule.

Vector Display

The **VECT** button calls up the Vector and Lightning displays, which provide for selection between two plots of the color portions of the signal. (See Figure 12.) (See Figure 13.)

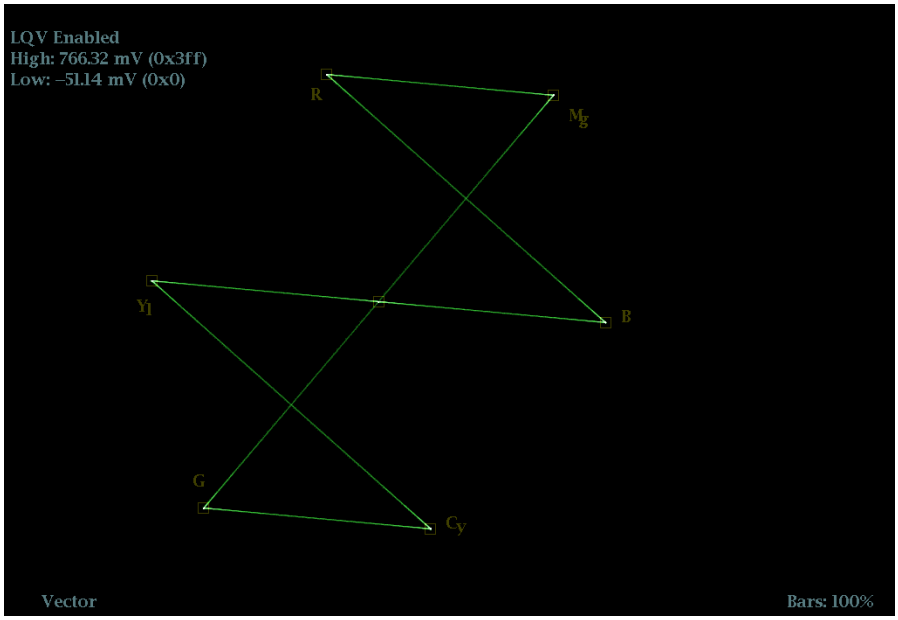


Figure 12: Vector display with Luma Qualified Vector (LQV) enabled

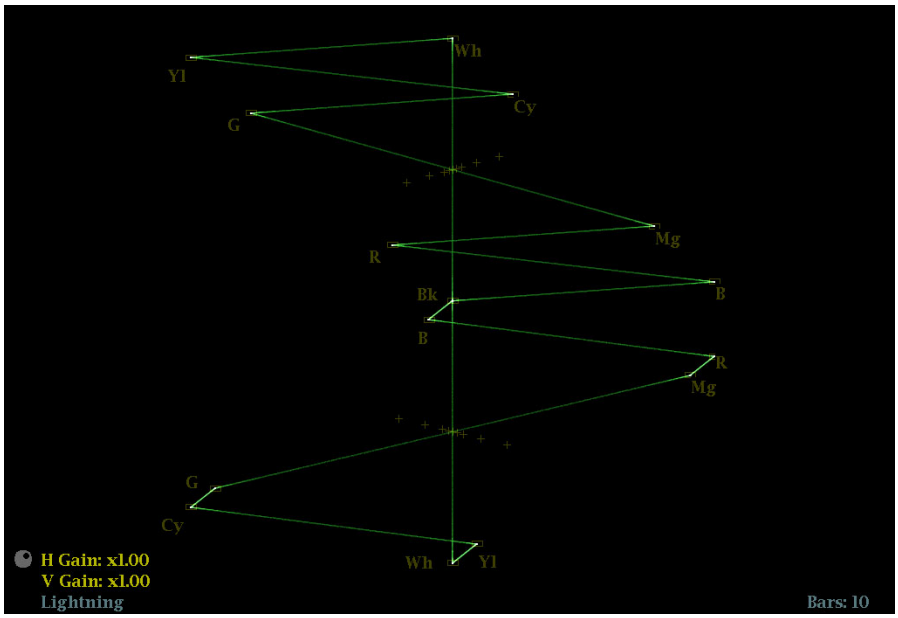


Figure 13: Lightning display

Elements of the Vector Display

The following elements appear on the display. Some elements may only appear on one display type:

- **V Gain.** Press and hold the GAIN button to select V Gain settings. Then select the gain to 1X, 2X, 5X, 10X, or Variable. (Variable enables you to adjust the vertical gain using the GENERAL knob.)
- **H Gain.** Press and hold the MAG button to select H Gain Settings. Then select the horizontal gain to 2X, 5X, 10X, or Variable. (Variable enables you to adjust the horizontal gain using the GENERAL knob.)
- **Display Type.** The selected display, either Lightning or Vector.
- **Bar Target Setting.** The bar target setting, either 75% or 100%.
- **LQV Enabled.** Luma qualified vector is enabled and luma high (**High**) and luma low (**Low**) values are displayed. (Requires Option PROD.)

Vector Pop-Up Menu

The Vector pop-up menu enables you to specify the display type and display mode (SDI inputs only), to set the bar targets, to turn on the Multi-Input display mode, and to center the waveform in the display.

If you have Option PROD installed, you can also select to turn Luma Qualified Vector On or Off. When it is on, you can set luma high and luma low parameters

To choose the display type (SDI inputs only), use the pop-up menu to choose:

- Vector – The Vector display shows a plot of the R-Y signal on the vertical axis and the B-Y signal on the horizontal axis. This display is useful for looking at hue and amplitude of the colors, but does not show luminance information.
- Luma Qualified Vector – The Luma Qualified Vector display (available with Option PROD) is a vector display that is gated by a specified luminance range. Each vector tile may have a different luminance range specified.
- Lightning – This Tek proprietary display shows the same color signals as in the Vector mode, but they are plotted against luminance. One color difference signal is plotted in the top half and the other in the bottom. The Lightning display is useful for checking chroma and luma gain, and for checking chroma to luma delay using the timing marks that show errors in the green to magenta transition on a color bar signal.

To select which scaling should be used in the active tile for either the Vector or Lighting display, use the menu to select 75% or 100% scaling.

To turn on the Multi-Input display mode, select **Multi-Input Display** and press **SEL**. Next, press and hold the **Display Select** button to view the display full-tile and activate the Multi-Input view.

NOTE. *The Multi-Input menu option is only available in the VECTOR pop-up menu when the feature is enabled from the MAIN button or CONFIG button menu. (See page 26, Multi-Input Display Mode.)*

To cancel any horizontal or vertical position adjustments and restore the trace to the default position, use the up/down arrow keys to select **Center Waveform** in the menu.

- For a Lightning display, press **SEL** to center the waveform. The trace is set back to the center of the tile.
- For a Vector display, press the right-arrow key to select the color you want to locate at the center of the display.
- For additional vector graticule options, see the CONFIG > Graticules and Readouts menu and select I/Q axis or Compass Rose.

TandemVu® (Overlay) Display

TandemVu® is a patented display that allows you to overlay the Waveform and Vector or Waveform and Lightning displays, plus Picture Thumbnail, in a single, full-tile display. You can then view Waveform and Vector displays, or Waveform and Lightning displays, at the same time. This feature allows you maximum visibility of each trace.

You can overlay the Vector display on the WFM display or the WFM display over the Vector display. Both overlay options are selected in the display pop-up menus. If you want to overlay the Lightning display, first select Lightning from the Vector menu, and then proceed to select overlay.

To enable TandemVu®, do the following:

1. Press and hold the **MAIN** button.
2. Check that **Display Overlay** is highlighted.
3. Press the **SEL** button to highlight **WFM & VEC**.

The screen will now show the displays overlayed. (See Figure 14.)

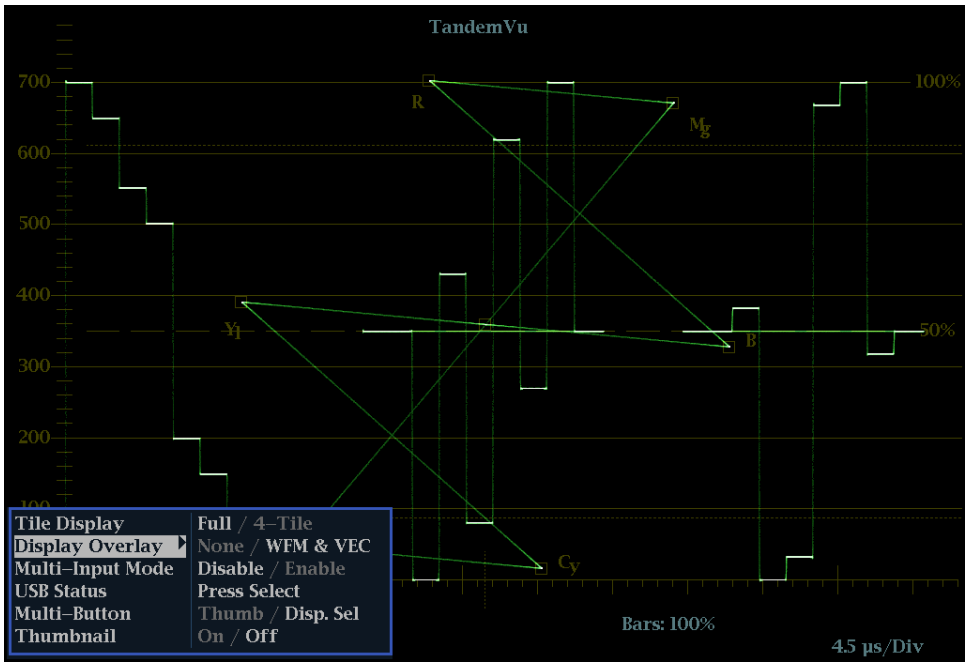
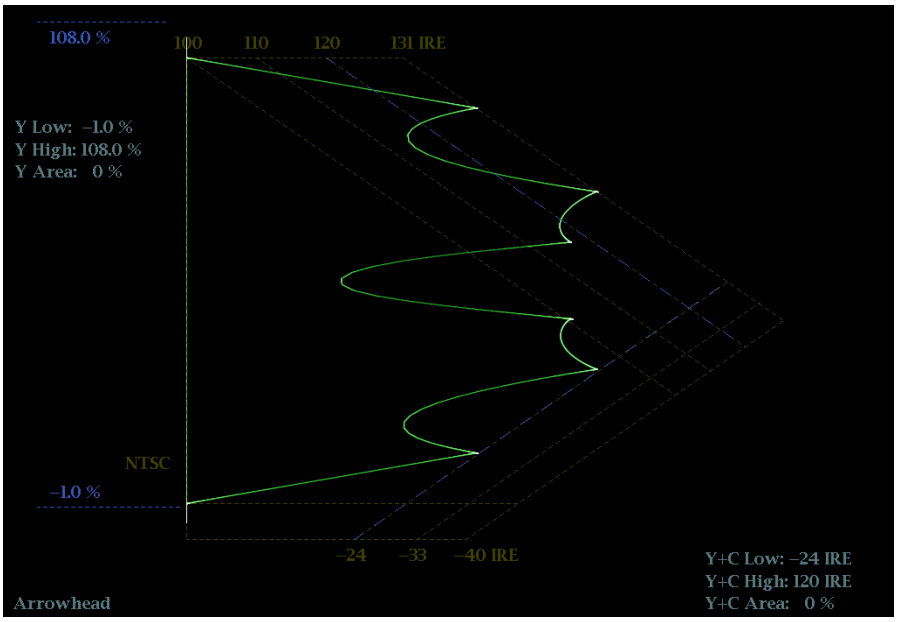


Figure 14: TandemVu® (Overlay) display and menu option

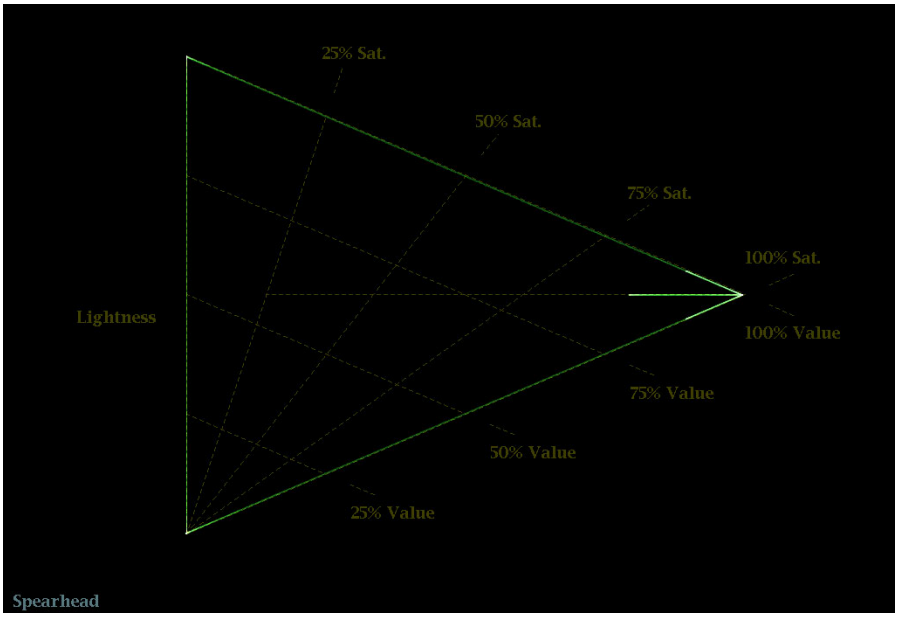
Gamut Display

Pressing the **GAMUT** button calls one of the Gamut displays. The Gamut display provides four proprietary Tektronix display types to enable you to check the gamut of an SDI signal. Set the thresholds for gamut displays from the CONFIG menu. The available Gamut displays are:

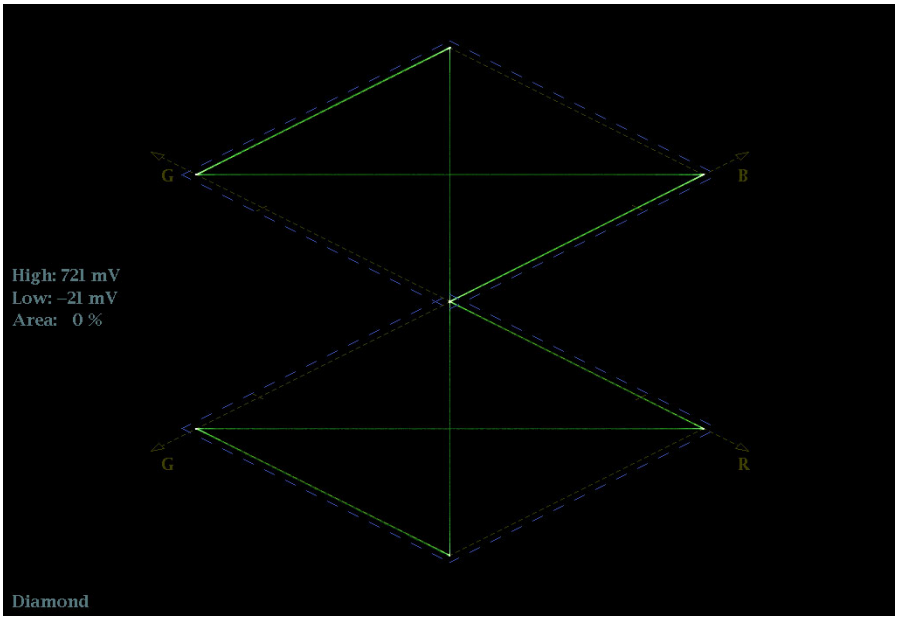
- **Arrowhead**: provides NTSC and PAL composite gamut information directly from the SDI signal



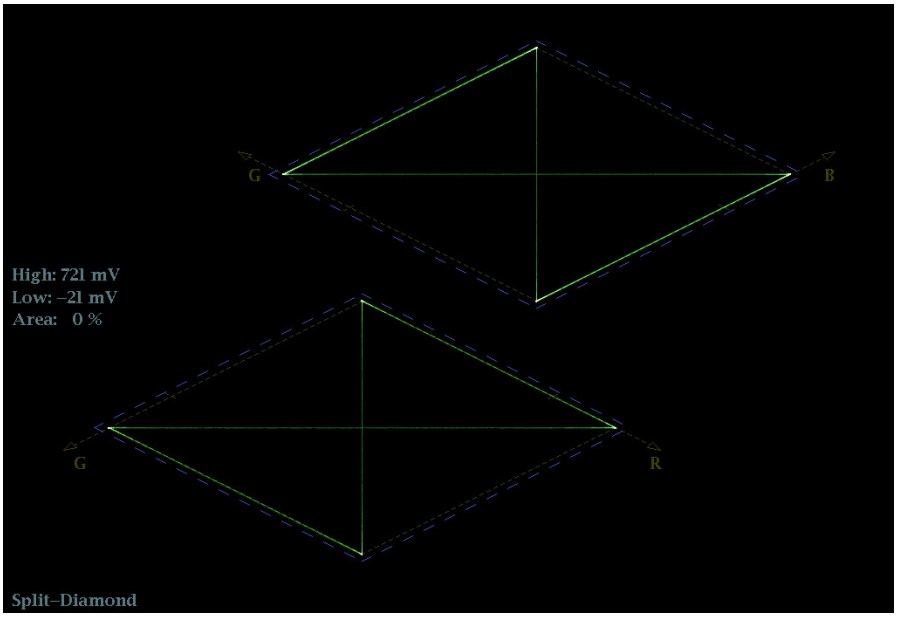
- **Spearhead**: shows lightness, color value, and saturation of the RGB color space (requires Option PROD)



- **Diamond**: provides a reliable method of detecting invalid colors



- **Split Diamond**: provides a reliable method of detecting invalid colors



Elements of the Gamut Display

- **High threshold:** Shows the currently specified high threshold (Diamond High or Arrowhead Max).
- **Low threshold:** Shows the currently specified low threshold (Diamond Low).
- **Gamut display type:** Shows the selected Gamut display type - Diamond, Split Diamond, Spearhead, or Arrowhead.
- **Threshold indicators:** Indicates the threshold settings using blue dashed lines.
- **Luma minimum:** Shows the currently specified minimum luma threshold (in the Arrowhead display).
- **Luma maximum:** Shows the currently specified maximum luma threshold (in the Arrowhead display).

GAMUT Pop-Up Menu

The GAMUT pop-up menu allows you to select the type of gamut display shown in the active tile and to turn on Multi-Input display mode. To change the display type, use the pop-up menu to select from the following displays:

- Diamond shows Gamut violations of the SDI input if translated to RGB color space.
- Split Diamond offsets the two halves of the Diamond to allow you to better see negative RGB Gamut errors.

- Arrowhead shows Gamut violations of the SDI input if translated to the Composite domain.
- Spearhead shows lightness, color value, and saturation of the RGB color space of all video signals, including dual link signals.

To turn on the Multi-Input display mode, select **Multi-Input Display** and press **SEL**. Next, press and hold the **Display Select** button to view the display full-tile and activate the Multi-Input view.

NOTE. *The Multi-Input menu option is only available in the GAMUT pop-up menu when the feature is enabled from the MAIN button or CONFIG button menu. (See page 26, Multi-Input Display Mode.)*

Timing Display

Pressing the **MEAS** button displays a Tektronix proprietary display that simplifies measuring the timing difference between two signals as the timing is corrected. Using the Timing display enables you to easily compare and correct the timing between two signals. (See Figure 15.)

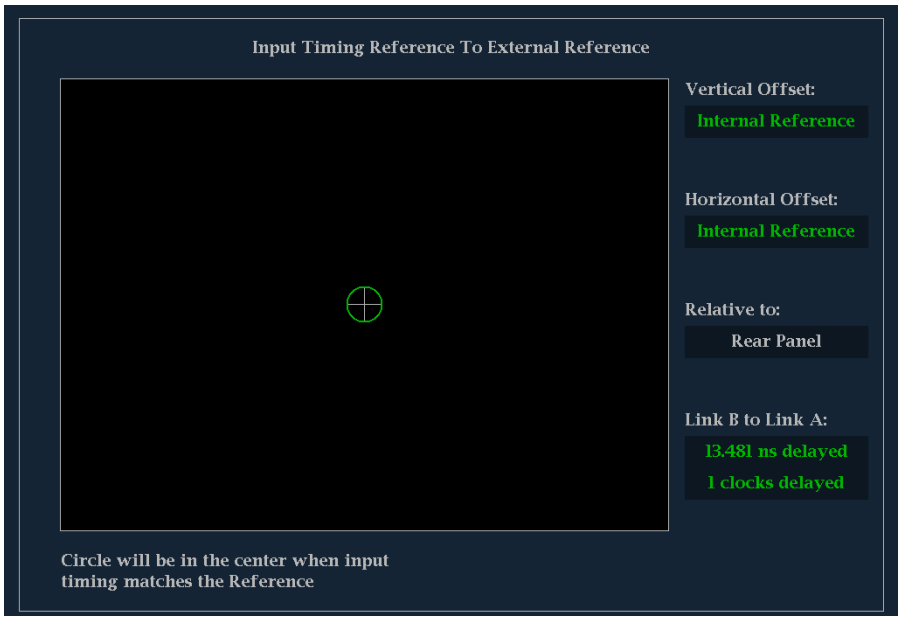


Figure 15: Timing display

Elements of the Timing Display

- **Input Signal Indicator:** A single circle representing timing of input signal relative to the reference. [1]
- **Reference Indicator:** A cross-hair indictor centered in the display represents the reference signal.

- **Vertical Offset:** The timing difference between the reference and input signal.
- **Horizontal Offset:** The timing difference between the reference and input signal.
- **Relative to:** Indicates the chosen zero point for the timing display. [2]
- **Link B to Link A:** Indicates the timing relationship between links of a Dual Link signal.

1 More complex timing relationships display multiple circles. See *Timing Displays for Simple Versus Complex Timing*. (See page 42.)

2 Rear Panel is the default setting, where offset is shown as zero when the input and reference are at the same timing at the rear panel of the instrument. If you select *Saved Offset*, you can save the timing from one signal, and then display the timing relative to that saved offset.

Measure Pop-Up Menu

The Measure pop-up menu enables you to save a timing setting for comparison with another signal and specify the zero point of the timing display.

To save the timing of the current input as an offset to the timing display, use the **Save Offset** menu entry. The current timing becomes the zero point for the saved offset mode of the timing display. This applies to both the cross-hair target in the middle of the display and the numeric readouts.

NOTE. *You cannot save the timing offset if either the input or reference is missing or unlocked. You also cannot save a reference when in internal mode. Saving an offset in these conditions would lead to misleading results so it is not allowed by the instrument. A warning message appears on the screen if you attempt to save the offset when it is not allowed.*

Save Offset allows you to measure the timing between inputs or to match multiple signals. To select the definition for the zero timing offset, use the Relative To: menu entry to select one of the following:

- **Rear Panel**, which means the timing offset is shown as zero when the two signals are timed down at the rear of the instrument.
- **Saved Offset**, which means that the timing is shown as zero offset when the input signal matches the timing of the signal that was present when the offset was saved using the Save Offset menu entry.

This selection changes both the numeric readouts and the target in the middle of the timing display.

Timing Displays for Simple Versus Complex Timing

The number of circles, with each representing a time offset, varies with the complexity of the timing between the reference and input signals.

Integer multiples of reference rates. If you are timing input signals with rates that are integer multiples of the reference rates, the instrument can measure the timing deterministically and displays the relationship as one circle (offset) relative to the cross-hair. (See Figure 16.)

Figure 16: Timing display of integer multiples of reference rates

Such cases include timing an NTSC input (multiplier of 1) or a 525 SDI input whose frame time is 33.36 ms (multiplier of 2), against an NTSC reference, which has a frame time of 66.73 ms.

Non-integer multiples of reference rates. If you time input rates that are not integer multiples of the reference rates, the instrument cannot measure the timing deterministically, so it displays the relationships as several circles. Each circle represents a possible timing offset measurement relative to the reference cross-hair. Display emphasis is given to the circle that times closest to zero offset and the numerical readouts track this pair. (See Figure 17.)

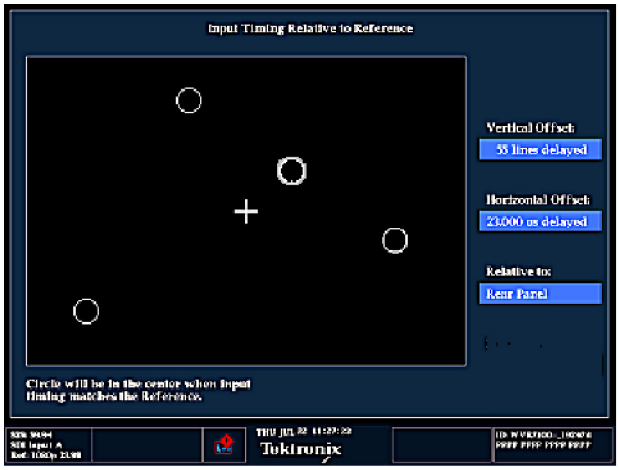
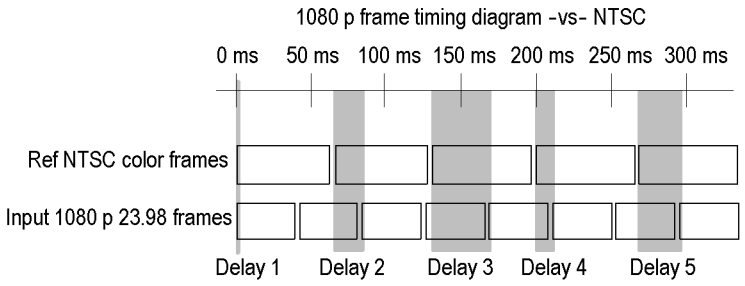


Figure 17: Timing display of non-integer multiples of reference rates

Non-deterministic cases include timing of slow rate inputs against fast frame-rate references or when timing video against film rates.

Multiple relationships. For a case where multiple relationships would display, consider an input of 1080p/23.98 Hz with a reference of NTSC/59.94 Hz:

- The different rates result in timing relationships between the signals that repeat once for every four fields of the input and five frames of the reference.
- Because this allows for five possible ways to measure timing between these two signals, the timing display shows four circles, with emphasis and readouts as previously described above.



Datalist Display

The Datalist Display is accessed from the **MEAS** button when Option DATA is installed. This display allows you to see SD, HD, or 3 Gb/s data without any interpolation.

The Datalist tool examines the contents of all digital formats, structures, and transports (SD, HD, dual-link, 3 Gb/s, 4:2:2, 4:4:4, and others). Datalist works for all signals except composite signals (analog NTSC and analog PAL). From the display screen, you can select and isolate specific lines and words from the video or data stream. (See Figure 18.)

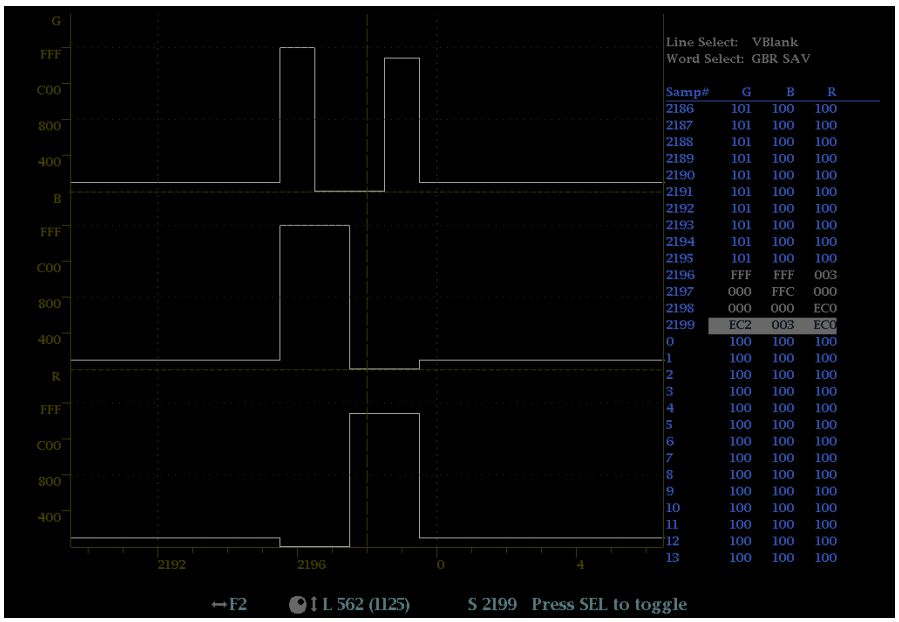


Figure 18: Datalist display

Elements of the Datalist Display

Use the navigation text on the bottom of the display screen to select line and sample items using the arrow keys and the General knob.

- **Line Select**: Shows which line is selected; press the **SEL** button to switch between Line Select and Word Select.
- **Word Select**: Shows which word is selected; press the **SEL** button to switch between Line Select and Word Select.
- **Samp#**: Shows the sample number.
- **Y0, Cb, Cr, Y1**: These labels change based on the signal, but they show the line number for each component.

Datalist Color Coding

Different fields of the data stream are shown in different colors:

- **Green**: Active video data.
- **Blue**: Data in horizontal or vertical blanking intervals.
- **White**: EAV and SAV packets; other reserved values such as the XYZ word.
- **Yellow**: Data outside the nominal allowed values.
- **Red**: Data with illegal values.

Quickly Finding SAV and EAV in the Active Video Stream

From anywhere in the video stream, pressing the **CURSOR** button once will take you immediately to the EAV of that line. Press it again to jump to the SAV of the same line. This is also an easy way to move quickly to the beginning of the ANC data, which is right after the EAV.

Datalist Display Pop-Up Menu

- **Trace Type**: Select from Video or Data. If you select Video, you can then select to turn on or off individual components (traces) of the display. (Default is Video.)
  - **Video** mode shows the data similar to the video YPbPr display in waveform mode, but without interpolation. The Y, Cb, and Cr traces are offset vertically to separate them, but are aligned temporally.
  - **Data** mode using a SD signal shows the data in the same sequence as it occurs in the serial domain. You see a sample of Y, then of Cb, then of Y' (Y prime), and then of Cr. Then the sequence repeats. The Y sample is the co-sited sample and the Y' sample is the isolated luma sample.

    Data mode using an HD signal splits the serial input into a Y channel and a multiplexed Cb/Cr channel. The intent is to show the data in the same block structure as it occurs in the serial domain, even though it is displayed as 8 or 10-bit values.
- **Format**: Select from Hexadecimal, Decimal, or Binary. (Default is Hexadecimal.)

Bowtie Display

The Bowtie Display is accessed from the **MEAS** button. This display allows you to look at inter-channel timing between Y Pb and Y Pr. The left side of the display compares Y and Pb; the right side compares Y and Pr. The Bowtie Display requires a test signal with signals of slightly differing frequencies on the chroma channels than on the luma channel.

If the bowtie patterns have a sharp null, and the null is at the center of each line, the relative amplitudes and inter channel timing are correct. Interchannel timing errors will move the position of the null. A relative amplitude error will decrease the depth of the null. An incomplete null combined with an offset from center indicates both amplitude and timing problems between the channels being compared. (See Figure 19.)

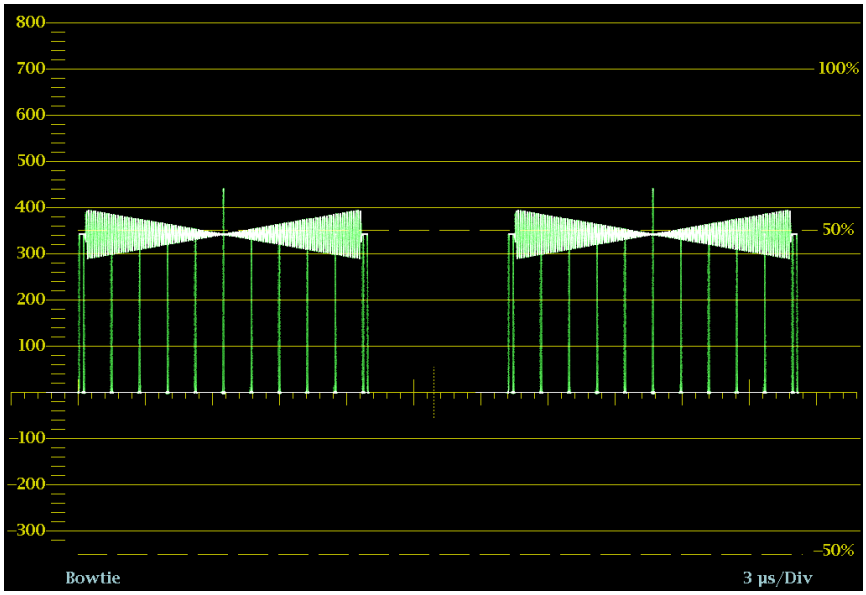


Figure 19: Bowtie display

Elements of the Bowtie Display

- **Display**: Shows the display type as Bowtie.
- **Y-axis units**: The units for the y-axis depend on the test signal and the signal format.
- **X-axis units**: Shows the x-axis in microseconds/divisions.

Bowtie Display Pop-Up Menu

- **Parade / Overlay**: Select how the waveform appears by selecting Parade or Overlay.
- **Center Waveform**: Press the **SEL** button to center the waveform.

LTC Display

The Longitudinal Time Code (LTC) Display is accessed from the **OTHER** button. LTC is monitored in a frame rate display to allow observation of amplitude, synchronization and phase with respect to reference vertical interval time code (VITC). (See Figure 21.)

The input of LTC is through the REMOTE connector on the rear panel of the instrument. The REMOTE connector is a 15-pin D-type connector with socket contacts. For pin information, see the *Installation and Safety* manual or the *System Integration* manual on the Product Documentation CD that shipped with your instrument and the Web at www.tektronix.com/manuals.

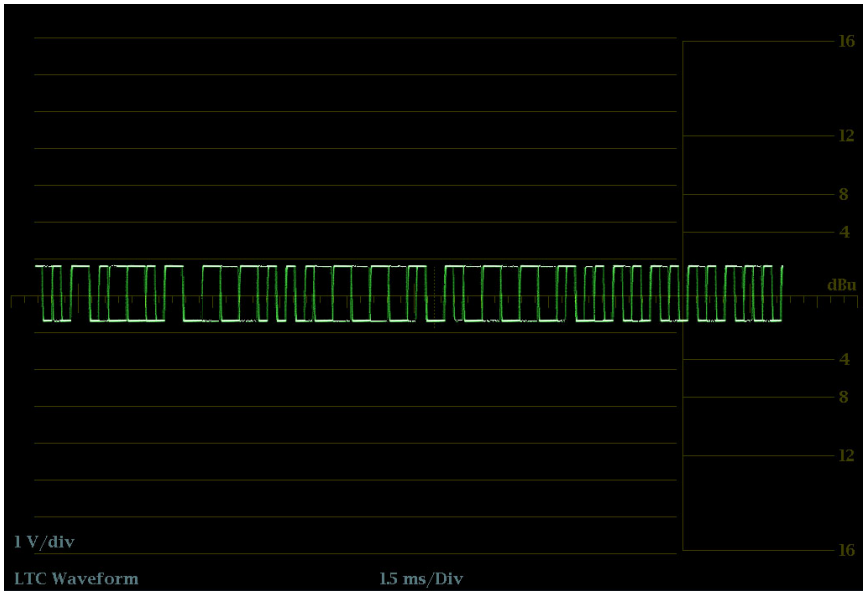


Figure 20: LTC display

Elements of the LTC Display

- **Display**: Shows the display type as LTC.
- **Y-axis units**: Shows the y-axis units in volts/divisions.
- **X-axis units**: Shows the x-axis in milliseconds/divisions.

LTC Display Pop-Up Menu

The OTHER pop-up menu allows you to select **Center Waveform** and press the **SEL** button to center the waveform.

External Reference Waveform Display

The External Waveform Display is accessed from the **OTHER** button. This display allows you to check the external reference signal integrity, including its shape and amplitude. This display is independent of the input video signal. (See Figure 21.)

The input of external reference waveform is through the EXT REF connector on the rear panel of the instrument.

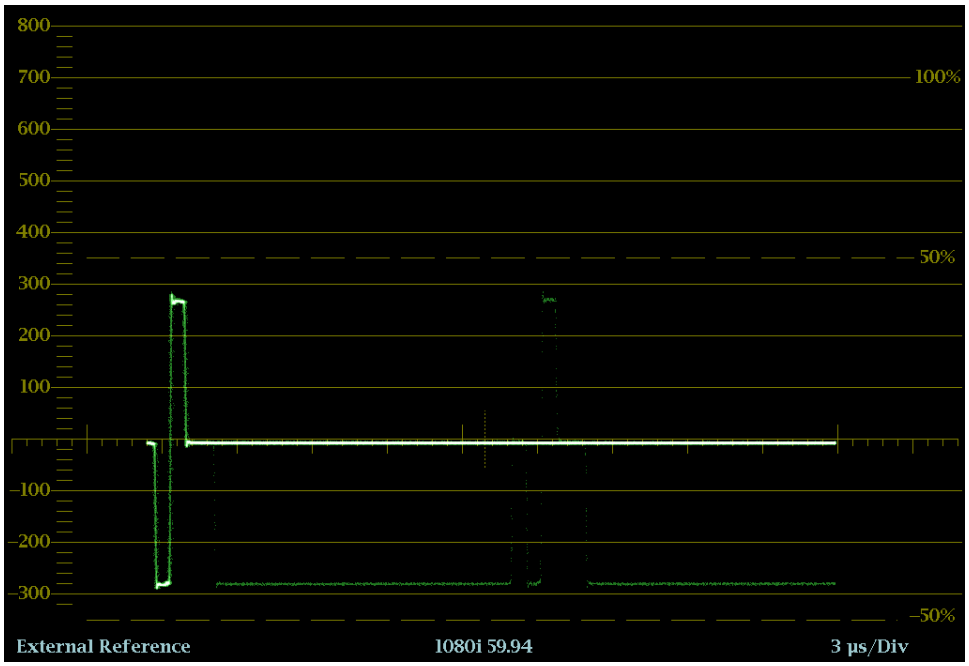


Figure 21: External reference waveform (tri-level sync signal)

Elements of the External Reference Waveform Display

- **Display**: Shows the display type as External Reference.
- **Y-axis units**: Shows the y-axis units in volts/divisions.
- **X-axis units**: Shows the x-axis in milliseconds/divisions.

External Reference Waveform Display Pop-Up Menu

The OTHER pop-up menu allows you to select **Center Waveform** and press the **SEL** button to center the waveform.

Ancilliary (ANC) Data Display

The ANC Data Display is available with Option DATA. It allows you to more closely examine all of the ANC data in a signal. The ANC Data Inspector is part of the ANC Data Display. This ancillary monitoring feature allows you to see all ancillary data present in a signal. The instrument continually monitors the signal and tells you when changes in the presence of data occur. When Watch List mode is activated, the instrument displays the presence and status of ANC data types you have selected in the Watch List. This allows you to focus on the ANC data types that are important to you.

The Detail area (lower part of the display) displays only when in full-tile mode. The Detail area can be expanded to show more data by pressing the MAG button. (See Figure 22.)

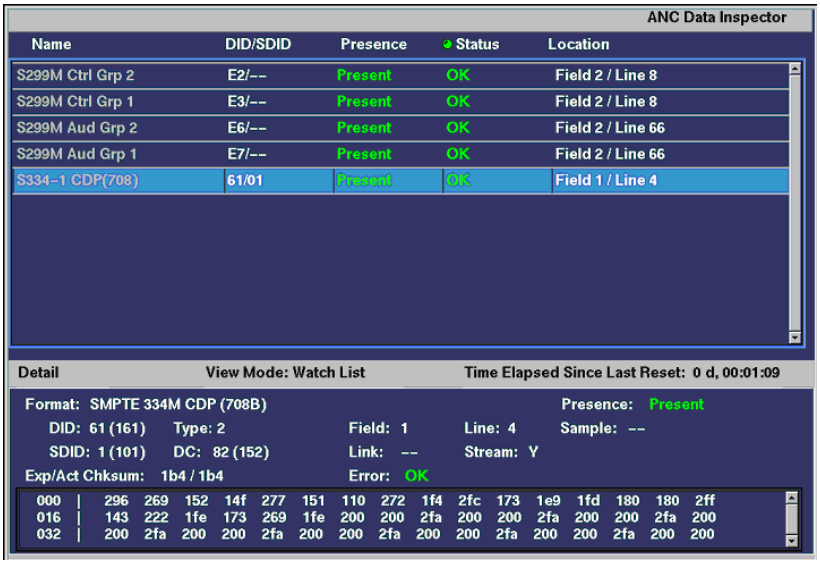


Figure 22: ANC Data display

Elements of the ANC Data Display

The following information is available on the ANC Data Display when in full screen mode:

- **DID**: Data Identifier of the requested packet; permissible values range from 1 to 0xFF (255) inclusive.
- **Type**: Type of the ANC Data packet; either Type 1 packet (DID greater than or equal to 0x80), or Type 2 packet (DID less than 0x80), as defined by SMPTE 291M; Type 1 packets do not have a SDID field, instead they have a DBN field; the "actual value" (with parity bits added) is displayed in parentheses.
- **SDID**: Secondary Data Identifier of the requested packet; permissible values range from 0 through 0xFF (255) inclusive; this field only appears when a Type 2 packet is selected; the "actual value" (with parity bits added) is displayed in parentheses (mutually exclusive with DBN field).

- **DBN**: Data Block Number of the acquired packet; values range from 0 to 0xFF; the "actual value" (with parity bits added) is displayed in parenthesis (mutually exclusive with SDID field).
- **DC**: Data Count word of the acquired packet; the number of User Data words is displayed in decimal; the "actual value" (with parity bits added) is displayed in parenthesis, in hexadecimal.
- **Field**: The field of the video from which the packet was acquired; for progressive formats, 1 is displayed.
- **Line**: The line of the video (within the field) from which the packet was acquired.
- **Stream**: For HD (SMPTE 292M), indicates whether the ancillary packet was acquired from the Y or C data streams; for SD, "N/A" is displayed.
- **Status**: Indicates whether packet(s) of the desired type are present in the video; also indicates Checksum or CRC errors.
- **Checksum**: Indicates the checksum word that was recovered from the acquired packet.
- **Should be**: Indicates the checksum work computed by the instrument, based on data of the packet.
- **Format**: Indicates the name of the ancillary data type or standard.
- **User Data Words**: Contains the payload of the ancillary packet, displayed in hexadecimal; all 10 bits are displayed.

Configuring the Watch List

The Watch List allows you to limit the data types viewed in the ANC Data Display to only those you specify. To configure the Watch List, perform the following steps:

1. Press the **CONFIG** button and select **ANC Data Display**.
2. Select **Config Watch List** from the menu.
3. Press the **SEL** button and a table of data types appears.
4. Check the boxes next to the data types you want to view in the ANC Data Inspector. Use the SELECT ALL and CLEAR ALL boxes to quickly select or clear all data types.
5. When you are finished selecting the data types, navigate to the **Return** box and press the **SEL** button.
6. Press the **CONFIG** button to dismiss the menu.
7. Press and hold the **MEAS** button and select **Display Type** and then **ANC Data Display** from the pop-up menu.

You can now view the data types you checked in the Watch List.

Status Displays

Pressing the **STATUS** button calls up the Status display, which provides several views of signal status. Status displays are text displays that show signal status. You can view current alarms and errors (those occurring now and within the last few seconds), a history of errors and alarms (up to 10,000 entries), video error statistics or audio error statistics. You can display a different Status display type in all four tiles.

Error Log

View a log of errors and control the error logging settings. (See Figure 23.)

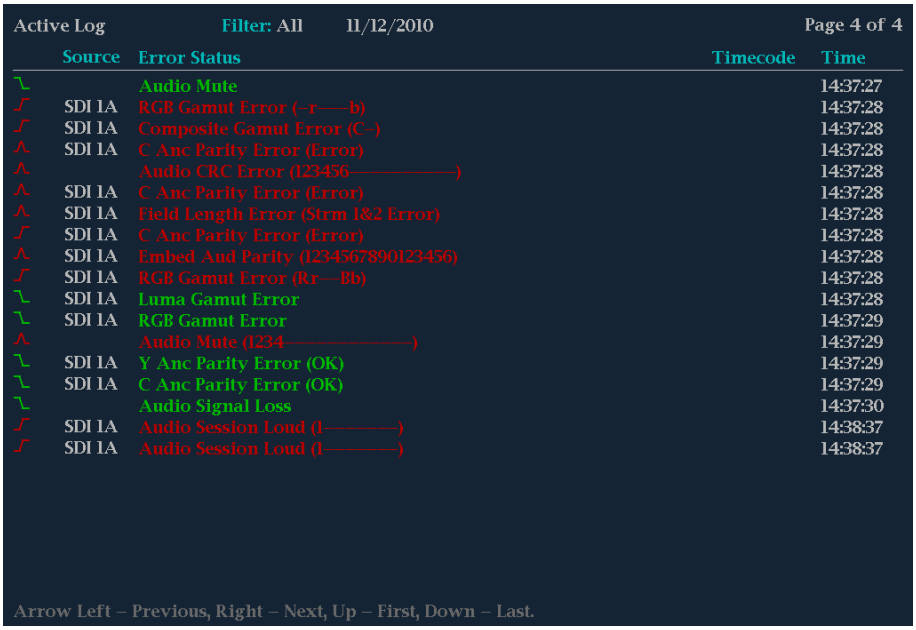

Active Log
Filter: All
11/12/2010
Page 4 of 4
Source
Error Status
Timecode
Time
Audio Mute 14:37:27
SDI 1A RGB Gamut Error (–r——b) 14:37:28
SDI 1A Composite Gamut Error (C–) 14:37:28
SDI 1A C Anc Parity Error (Error) 14:37:28
Audio CRC Error (123456————) 14:37:28
SDI 1A C Anc Parity Error (Error) 14:37:28
SDI 1A Field Length Error (Strm 1&2 Error) 14:37:28
SDI 1A C Anc Parity Error (Error) 14:37:28
SDI 1A Embed Aud Parity (1234567890123456) 14:37:28
SDI 1A RGB Gamut Error (Rr—Bb) 14:37:28
SDI 1A Luma Gamut Error 14:37:28
SDI 1A RGB Gamut Error 14:37:29
Audio Mute (1234————) 14:37:29
SDI 1A Y Anc Parity Error (OK) 14:37:29
SDI 1A C Anc Parity Error (OK) 14:37:29
Audio Signal Loss 14:37:30
SDI 1A Audio Session Loud (1————) 14:38:37
SDI 1A Audio Session Loud (1————) 14:38:37
Arrow Left – Previous, Right – Next, Up – First, Down – Last.

Figure 23: Error log

Elements of the Error Log display.

Across the top of the display screen, the following items are shown:

- **Log status**: Shows that the currently viewed log is active (**Active Log**) or that logging has stopped (**Active Log (Stopped)**).
- **Filter**: Shows the currently selected error filter. *All* means that all errors from all inputs and channels are being shown. You can also select to view errors by input or channel.
- **Date**: Shows the date, according to the internal clock, that the error occurred. The date is displayed as month/day/year.
- **Page**: Shows which page you are viewing out of the total number of pages in the log.

The Error Log is also divided into the following four columns:

- **Source**: Shows the inputs on which the errors have occurred.
- **Error Status:** Shows the current state of the entry: **White** items are informational and identify a change in instrument state; **Green** items are errors that have cleared; **Red** items are triggered errors.
- **Timecode:** Shows the time, according to VITC or LTC in the signal, that the error occurred. In the case of ongoing errors, this shows the time the error first occurred.
- **Time:** Shows the time, according to the internal clock, that the error occurred.

Error Log pop-up menu.

- **Mute Alarms:** Mutes alarms for all Status display types.
- **Logging Active:** Turns alarm error logging On or Off.
- **Logging Reset:** Press the **SEL** button to clear the log.
- **Input/Channel:** Allows you to select to filter errors in the error log so that you can view them by channel or input. When the instrument is in SIM mode, you can select to view errors from only Channel 1 (the left channel) or Channel 2 (the right channel).
- **Save to USB (ALL)**: Saves the entire unfiltered error log to a USB memory device.
- **Save to USB (Sel.)**: Saves only the errors in the error log for the selected channel or input to a USB memory device.

Alarm Status

View current alarm status. (See Figure 24.)

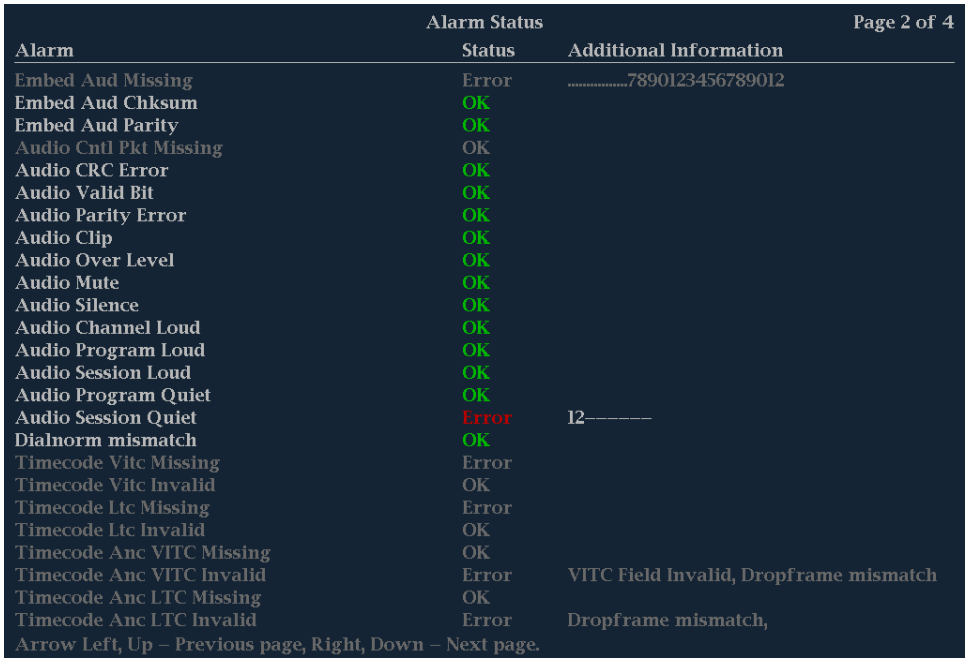


Figure 24: Alarm Status display

Elements of the Alarm Status display.

- **Alarm:** Shows alarms that occurred.
- **Status:** Shows whether an error occurred but has cleared (**green**), whether an error has appeared in the last five seconds but has cleared (**yellow**), or whether an error is ongoing (**red**). Gray indicates the alarm is not being logged but still provides information on the function.
- **Additional Information:** Provides explanatory information about the error, if available.

Alarm Status pop-up menu. **Mute Alarms** mutes alarms for all Status display types.

Video Session

The Video Session display contains several performance parameters that you can view to get an overview of the video input signal. This instrument maintains a running video status session. (See Figure 25.)

Video Session
Input: SDI 1A
Signal: Locked
Effective: Auto 1080i 59.94 – HD SDI 422 – 292M 1.485/M Gbps
Selected: Auto Format – Auto Structure – Auto Transport
352M Payload: None
SAV Place Err: OK
Field Length Err: OK
Line Length Err: OK
Line Number Err: OK
Ancillary Data: Y and C Present
Y Stuck Bits: ____ ____ __
C Stuck Bits: ____ ____ __
Statistics Status Err Secs Err Fields % Err Fields
RGB Gamut Error OK 11738 644144 37.4338 %
Cmpst Gamut Error C– 6762 378333 21.9864 %
Luma Gamut Error OK 1690 33251 1.9323 %
Y Chan CRC Error OK 591 47727 2.7309 %
C Chan CRC Error OK 591 47727 2.7309 %
Y Anc Checksum Error OK 0 0 0.0000 %
C Anc Checksum Error OK 0 0 0.0000 %
Black Events: 0
Frozen Events: 1
Changed since reset: N/A
Run Time: 1 d, 06:51:18
Running
Press "SEL" to reset. Any "arrow key" stops/starts.

Figure 25: Video Session display of HD signal

SDI elements of the Video Session display. The following elements are visible when SDI 1A or 1B is the selected signal:

- **Input**: Shows the selected input source.
- **Signal**: Indicates whether the instrument is locked to the selected input.
- **Effective**: Shows, in order, the detected format, sample structure, and transport of the input signal.
- **Selected**: Shows, in order, the selected format, sample structure, and transport of the instrument.
- **352M payload**: Indicates the presence of a SMPTE 352M payload.
- **SAV Place Err**: Indicates whether a Start-of-Active-Video Placement Error has occurred.
- **Field Length Err**: Indicates whether a Field Length Error has occurred.
- **Line Length Err**: Indicates whether a Line Length Error has occurred.
- **Ancilliary Data**: Indicates whether Ancillary Data is present in the video signal. The displayed values are either Present or None for SD signals, or Y and C Present and None for HD and 3 Gb/s signals.
- **F1 AP CRC**: For SD signals only, calculates and displays the active picture CRC (Cyclical Redundancy Check) for field one in hexadecimal. The

instrument uses the SMPTE RP165 standard for error checking. For HD and 3 Gb/s signals, the CRCs change on every video line.

- **F2 AP CRC**: For SD signals only, calculates and displays the active picture CRC (Cyclical Redundancy Check) for field two in hexadecimal. The instrument uses the SMPTE RP165 standard for error checking. For HD and 3 Gb/s signals, the CRCs change on every video line.
- **Data Collect**: Shows the state of error gathering. The possible states are:
  - **Running**: Indicates errors are being gathered and displayed on the status page.
  - **Stopped**: Indicates errors are not being gathered. The status page is not being updated.
  - **Resetting**: Appears briefly after the SEL button is pressed to reset the statistics.
- **Runtime**: The time since the last reset occurred. Time is displayed as "DD, HH:MM:SS", where DD is the number of days, HH is the number of hours, MM is the number of minutes, and SS is the number of seconds.
- **Stuck Bits**: For SD signals only, displays which of the video bits are stuck. If the readout is "—- —- –", then none of the bits are stuck.
- **Y Stuck Bits**: For HD signals only, displays which of the luminance video bits are stuck. If the readout is "—- —- LL", then none of the bits are stuck. LL is displayed for the two unused bits.
- **C Stuck Bits**: For HD signals only, displays which of the chrominance video bits are stuck. If the readout is "—- —- LL", then none of the bits are stuck. LL is displayed for the two unused bits.
- **EDH Error**: For SD signals only, indicates that there is an error in the EDH packet (checksum or parity) of the signal.
- **Statistics**: This section of the display shows the status and statistical values for certain errors. For information about the errors in this section, view the help file in your instrument: while the Video Session is active in a tile, press the HELP button.
- **Status**: Shows the status of the associated error as either OK, Invalid, Missing, or Error.
- **Err Secs**: The number of seconds, since the last reset, that contained at least one error.
- **Err Fields**: The number of fields, since the last reset, that contained at least one error.
- **% Err Fields**: Shows a calculated number showing the percentage of all fields since the last reset that contained at least one error.

- **Black Events**: Shows when a black frame has occurred within the video image. Settings configured in the CONFIG > Measurement Settings menu.
- **Frozen Events**: Shows when a frozen frame has occurred within the video image. Settings configured in the CONFIG > Measurement Settings menu.
- **Changed Since Reset**: Indicates if either the F1 or F2 AP CRC values have changed since the last reset.
- **Frozen**: This readout only appears when you press the CAPTURE button. It indicates that errors are being gathered, but are not being displayed on the Status page. This state is useful for looking at EDH (Error Detection and Handling) CRC (Cyclic Redundancy Check) values on live video.

Video Session pop-up menu.

NOTE. *To reset, stop, or start an individual video or audio session, select the tile in which it is displayed and use the SEL button, right arrow key, and left arrow key, respectively. Remember that the STATUS pop-up menu must be closed; otherwise, the button and key presses will navigate through that menu.*

- **Mute Alarms:** Mutes alarms for all Status display types.
- **All Sessions Reset:** Globally resets any and all video sessions displayed in all panes, regardless of the display and session from which it is executed.
- **All Sessions Start:** Globally starts any and all stopped video sessions displayed in all panes, regardless of the display and session from which it is executed.
- **All Sessions Stop:** Globally stops any and all stopped video sessions displayed in all panes, regardless of the display and session from which it is executed.

Audio Session

With Option AUD, you can access the Audio Session display, which contains several performance parameters that you can display to see an overview of the audio input signal. This instrument maintains a running audio status session. (See Figure 26.)

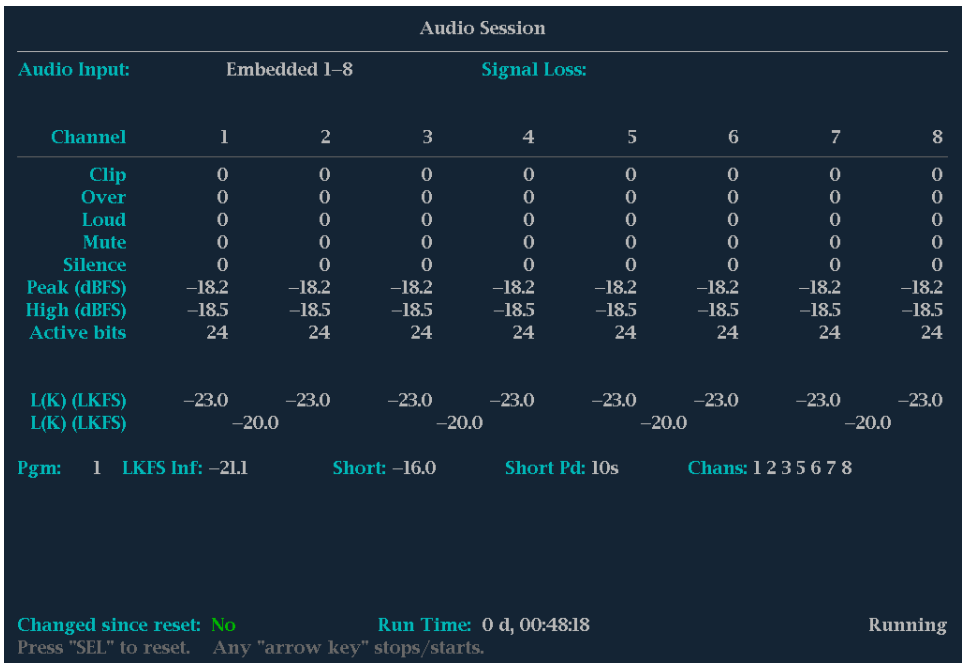

Audio Session
Audio Input: Embedded 1–8
Signal Loss:
Channel 1 2 3 4 5 6 7 8
Clip 0 0 0 0 0 0 0 0
Over 0 0 0 0 0 0 0 0
Loud 0 0 0 0 0 0 0 0
Mute 0 0 0 0 0 0 0 0
Silence 0 0 0 0 0 0 0 0
Peak (dBFS) –18.2 –18.2 –18.2 –18.2 –18.2 –18.2 –18.2 –18.2
High (dBFS) –18.5 –18.5 –18.5 –18.5 –18.5 –18.5 –18.5 –18.5
Active bits 24 24 24 24 24 24 24 24
L(K) (LKFS) –23.0 –23.0 –23.0 –23.0 –23.0 –23.0 –23.0 –23.0
L(K) (LKFS) –20.0 –20.0 –20.0 –20.0
Pgm: 1 LKFS Inf: –21.1 Short: –16.0 Short Pd: 10s Chans: 1 2 3 5 6 7 8
Changed since reset: No Run Time: 0 d, 00:48:18 Running
Press "SEL" to reset. Any "arrow key" stops/starts.

Figure 26: Audio Session display

Elements of the Audio Session display.

- **Audio Input**: Shows the selected input source.
- **Signal Loss**: Indicates the level meter bars (1-8) that have triggered a signal loss alarm. Dashes indicate that no alarm was triggered.
- **Data Collect**: Indicates the status of error collection as Running or Stopped.
- **Channel**: This row aligns the channel number with the status readouts that appear below the row.
- **Clip**: The number of CLIPs detected during the session. (Only displayed for digital audio feeds.)
- **Over**: The number of OVERs detected during the session. (Only displayed for digital audio feeds.)
- **Loud**: The number of times the Analog Audio or Digital Audio loudness alarms have been trigger during the current session.
- **Mute**: The number of MUTEs detected during the session.
- **Silence**: The number of SILENCEs detected during the session.

- **Peak (dBFS)**: The True Peak signal level measured on the channel.
- **High (dBFS)**: The highest signal level measured by the signal level meter. The level meter response is based on the Ballistics setting. If ballistics is set to True Peak, this readout is the same as the Peak readout.
- **Active Bits**: The number of active bits in the channel. For SD Embedded Audio the maximum is 20 bits.
- **Smpl Rate**: The sample rate of the channel pair.
- **L (K)/(eq) (dBFS)**: The average loudness level for each channel. This can be either a "long" (averaged over the entire session), or "short" (averaged over a 10-second rolling interval) average.

NOTE. *When **AUDIO** > **Loudness Filter & Measure** > **Linear** is selected, **Leq (dBFS)** is displayed; for A-weighted loudness, **LAeq (dBFS)** is displayed; for LKFS ITU-R BS.1770 loudness, **L(K) (dBFS)** is displayed.*

- **L (K)/(eq) (pair)**: The average loudness level for each pair of channels. This can be either a "long" (averaged over the entire session), or "short" (averaged over a 10-second rolling interval) average.

NOTE. *When **AUDIO** > **Loudness Filter & Measure** > **Linear** is selected, **Leq (pair)** is displayed; for A-weighted loudness, **LAeq (pair)** is displayed; for LKFS ITU-R BS.1770 loudness, **L(K) (pair)** is displayed.*

- **Program (number) Loudness**: Represents the running average loudness for selected channels from the current audio input. This value is derived over the entire session, so the sample period is infinite. It is also known as the "long" loudness average.
- **Short**: Represents the running average loudness for selected channels for the current audio input. This value is derived from a short period duration set by the user. It is commonly referred to as the "short" loudness average.
- **Short Pd**: The Short Period defines the duration of the short Loudness average and is defined by the user within the Config menu for Loudness Settings.
- **Chans**: The Channels Summations shows the number of channels that are currently summed together for the Loudness average.
- **Changed Since Last Reset**: Either Yes or No. Indicates whether an error has occurred since the last reset.

Audio Session pop-up menu.

NOTE. *To reset, stop, or start an individual audio or video session, select the tile in which it is displayed and use the SEL button, right arrow key, and left arrow key, respectively. Remember that the STATUS pop-up menu must be closed; otherwise, the button and key presses will navigate through that menu.*

- **Mute Alarms**: Mutes alarms for all Status display types.
- **Loudness Avg**: Allows you to choose the duration over which the loudness count is averaged: **Long** is calculated on the interval of time since the last session reset; **Short** is calculated on the most recent 10 second interval.
- **All Sessions Reset**: Globally resets any and all audio sessions displayed in all panes, regardless of the display and session from which it is executed.
- **All Sessions Start**: Globally starts any and all stopped audio sessions displayed in all panes, regardless of the display and session from which it is executed.
- **All Sessions Stop**: Globally stops any and all stopped audio sessions displayed in all panes, regardless of the display and session from which it is executed.

Audio Loudness Session

The Audio Loudness Session display is available when Option LOUD and Option AUD are installed. This display allows you to view an audio loudness chart and the values associated with audio loudness measurements. This instrument maintains a running audio loudness session. (See Figure 27.)

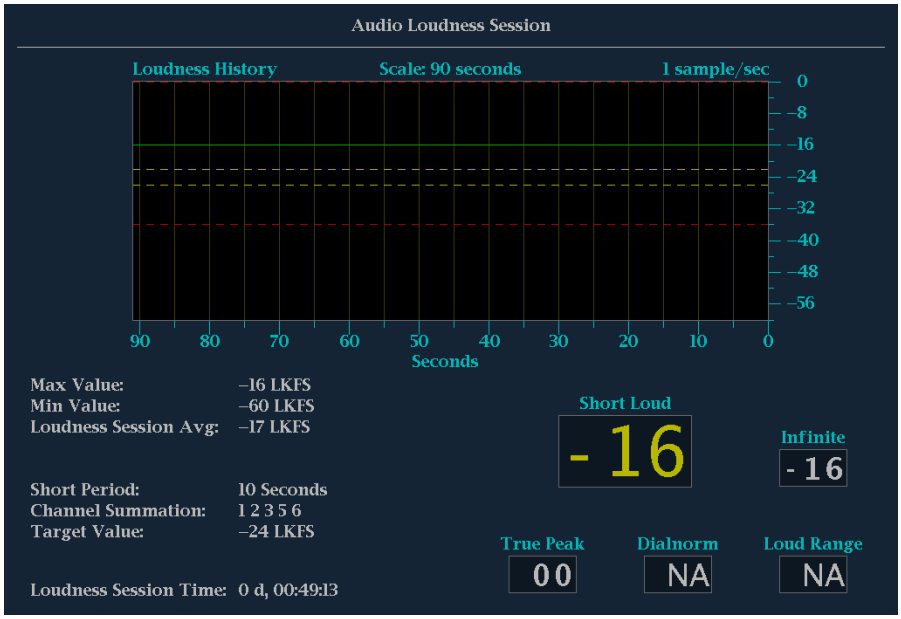


Figure 27: Audio Loudness Session display

Configuring loudness parameters from the configuration menu. From the **Loudness Settings** menu in the **CONFIG** button menu, you can set the parameters that affect loudness measurements. For example, the **Loudness Filter/Measure** selection controls which of three weighting filters are applied to the audio loudness measurement. It is used by the loudness algorithm to calculate the audio loudness.

Elements of the Audio Loudness Session display.

- **Max Value**: Shows the maximum loudness value recorded during the session.
- **Min Value**: Shows the minimum loudness value recorded during the session.
- **Loudness Session Avg**: Shows the loudness session average, which is a summed average of all the values recorded in the session.
- **Short Period**: Shows the current duration of the short period loudness average.
- **Channel Summation**: Shows the summation of audio channels currently used to compute the loudness average.
- **Target Value**: Shows the currently defined Target Loudness level.
- **Loudness Session Time**: Shows the current duration of the loudness session since last reset.

- **Short Loud**: The displayed value is the short duration loudness measurement based on the short duration period.
- **Infinite**: The displayed value is the loudness measurement average based on the duration of the audio session.
- **True Peak**: The displayed value is the maximum true peak value recorded by the audio meters. More detailed information on the true peak level of each channel is displayed within the audio session.
- **Dailnorm**: The displayed value is the metadata value that is present either within the Dolby data stream or carried as a Ancillary data packet per SMPTE2020.
- **Loud Range**: The displayed value is the quantified (in LU) variation of the loudness measurement of a program and is based on the statistical distribution of loudness.

Audio Loudness Session pop-up menu.

- **Mute Alarms**: Temporarily mutes alarm reporting.
- **Graph Scale**: Allows you to change the horizontal scale of the chart from 0 to 60 seconds to a total duration of up to 30 hours.
- **Graph Gain**: Allows you to change the vertical gain of the chart between 0-60 dB, 8-40 dB, and 12-36 dB.
- **Save History to USB**: Saves the audio loudness session history to a USB memory device.
- **History Reset**: Resets the audio loudness session history.
- **All Sessions Reset**: Globally resets any and all audio and video sessions displayed in all panes, regardless of the display and session from which it is executed.

Audio Control

The Audio Control Packet Display allows you to view information on audio frame number, sampling frequency, active channels, and relative audio-to-video delay of each channel, as encoded in the audio control packet metadata. (See Figure 28.)

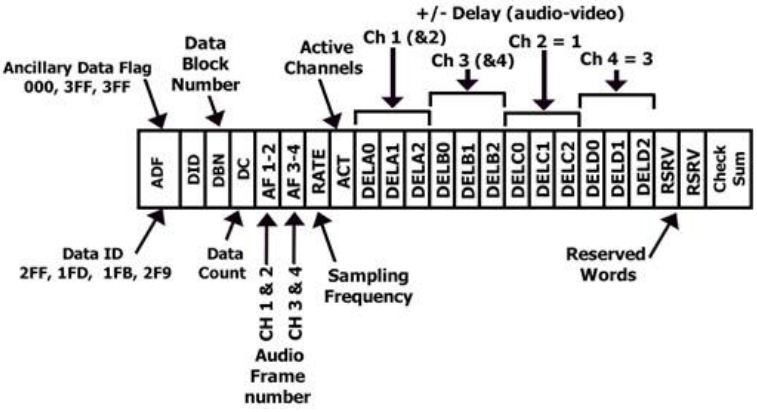


Figure 28: Audio Control Packet format

For SD signals, transmission of audio control packets is optional for 48 kHz synchronous operation and required for all other modes of operation (since it contains the information as to what mode is being used). Where frequent switching is planned, receiving equipment can be designed to add or drop a sample following a switch in the four out of five cases where the sequence is broken. The challenge in such a system is to detect that a switch has occurred. This can be facilitated by use of the data block number in the ancillary data format structure and by including an optional frame counter with the unused bits in the audio frame number word of the audio control packet. (See Figure 29.)

For HD signals, the audio control packet carries additional information used in the process of decoding the audio data and has a similar structure to standard definition.

The elements of the Audio Packet display vary depending on the monitored signal. (See Figure 30.)

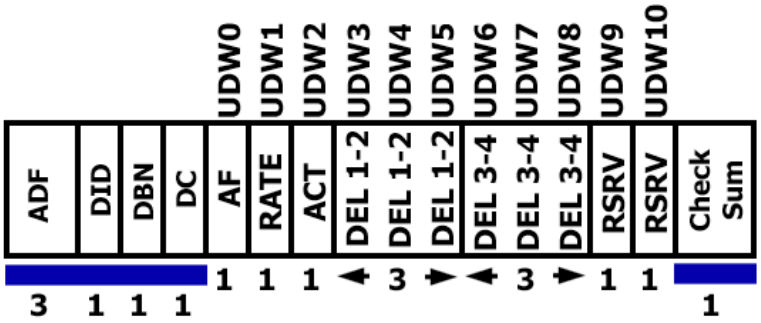


Figure 29: Audio Control Packet structure

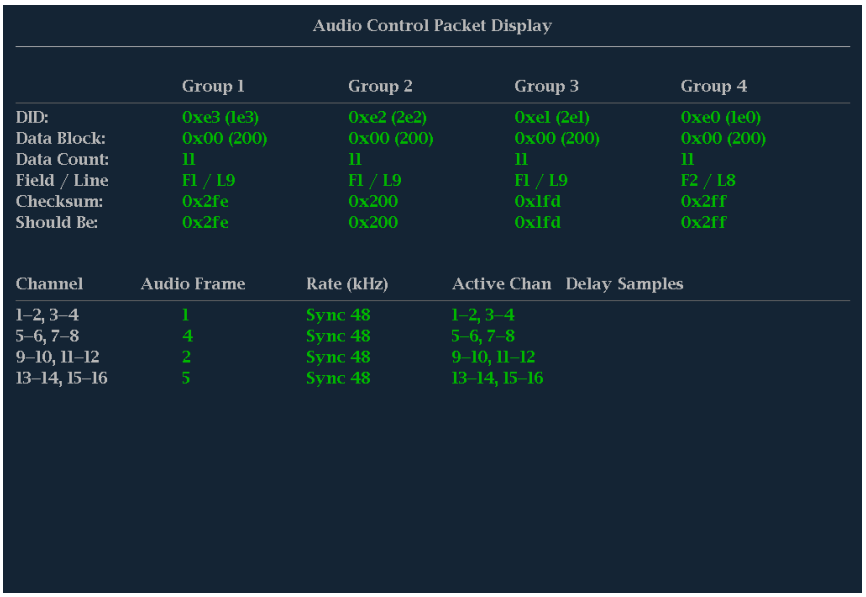

Audio Control Packet Display
Group 1 Group 2 Group 3 Group 4
DID: 0xe3 (1e3) 0xe2 (2e2) 0xe1 (2e1) 0xe0 (1e0)
Data Block: 0x00 (200) 0x00 (200) 0x00 (200) 0x00 (200)
Data Count: 11 11 11 11
Field / Line F1 / L9 F1 / L9 F1 / L9 F2 / L8
Checksum: 0x2fe 0x200 0x1fd 0x2ff
Should Be: 0x2fe 0x200 0x1fd 0x2ff
Channel Audio Frame Rate (kHz) Active Chan Delay Samples
1–2, 3–4 1 Sync 48 1–2, 3–4
5–6, 7–8 4 Sync 48 5–6, 7–8
9–10, 11–12 2 Sync 48 9–10, 11–12
13–14, 15–16 5 Sync 48 13–14, 15–16

Figure 30: Audio Control display

Elements of the Audio Control display.

- **Group 1 through *n***: Shows the audio group number of the audio control packet to be used for decoding.
- **DID**: Shows the Data Identifier of the ancillary data packet for the audio control packet. For specific information about permissible DID values, view the help file in your instrument: while the Audio Control display is active in a tile, press the HELP button and follow the link at the bottom of the page to *Audio Control Packet Display Elements*.

- **Data Block**: Always 200h for HD. If SD is present, this increments by 1 when consecutive data for each DID is present, or when data blocks within a common data ID are to be linked.
- **Data Count**: 10Bh for HD. For SD, the data count represents the number of user data words to follow, up to a maximum of 255 words.
- **Field/Line**: Shows the field of the audio from which the packet was acquired. The line of the audio (within the field) from which the packet was acquired.
- **Checksum**: Shows the checksum word that was recovered from the acquired packet.
- **Should be**: Shows the checksum word computed by the instrument, based on the packet data.
- **Channel**: Shows the specific channel(s) to which the Audio Frame, Rate (kHz), Active Chan, and Delay Samples data apply.
- **Audio Frame**: Audio frame (AF) number data provide a sequential numbering of video frames that indicate where they fall in the progression of the non-integer number of samples per video frame (audio frame sequence). The first number of the sequence is always 1 and the final number is equal to the length of the audio frame sequence. An audio frame value of one or more zeroes indicates that frame numbering is not available.
- **Rate (kHz)**: Shows the audio sampling rate.
- **Active Chan**: Shows whether the audio channel is active or inactive.
- **Delay Samples**: Shows the amount of accumulated audio processing delay relative to video, measured in audio sample intervals.

Audio Control Pop-up Menu. **Mute Alarms** mutes alarms for all Status display types.

Aux Data Status

The Aux Data Status Display allows you to view closed-caption, teletext, video index, AFD, WSS, V-chip related status, and other ancillary data present on monitored signals. (See Figure 54.)

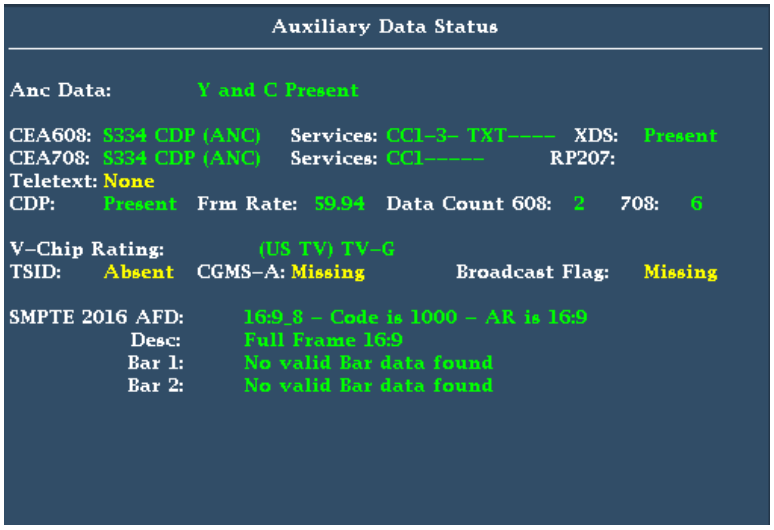

Auxiliary Data Status
Anc Data: Y and C Present
CEA608: S334 CDP (ANC) Services: CC1-3- TXT---- XDS: Present
CEA708: S334 CDP (ANC) Services: CC1----- RP207:
Teletext: None
CDP: Present Frm Rate: 59.94 Data Count 608: 2 708: 6
V-Chip Rating: (US TV) TV-G
TSID: Absent CGMS-A: Missing Broadcast Flag: Missing
SMPTE 2016 AFD: 16:9_8 - Code is 1000 - AR is 16:9
Desc: Full Frame 16:9
Bar 1: No valid Bar data found
Bar 2: No valid Bar data found

Figure 31: Auxiliary Data Status display

Elements of the Aux Data Status display.

- **Ancillary Data Present**: Indicates if ANC data is present in the SDI stream.
- **CC/Teletext Type**: Indicates the Closed Caption or Teletext type in use, with the element turning red if an error is detected or the type is missing. Possible values are CEA-608 (VBI), CEA-608 (ANC), CEA-608 (708), CEA-708, Teletext B (WST) / VBI, Teletext B (WST) / OP47 SDP, Teletext B (WST) / OP47 Multi. If the CC type data is present, but is either late or early, the error message is displayed in yellow.
- **CEA 608**: Indicates the number and type of services present in the closed caption data CEA608 format. If a service has no activity for 30 seconds, it is considered missing.
- **CEA 708**: Indicates the number and type of services present on closed caption data in CEA708 format. If a service has no activity for 30 seconds, it is considered missing.
- **RP207**: Indicates the presence of Program Description Data.
- **Teletext**: Detects the location and line numbers for which teletext information is present.
- **CDP**: Indicates the presence of Caption Distribution Packets and provides information on frame rate and data count of 608 and 708 packets. Note that packet 608 typically has 4 data words and packet 708 has up to 46 data words, depending on the frame rate as defined in SMPTE 334.

- **V-Chip Rating**: Detects ratings from: MPAA (US), TV (US), Canadian English, and Canadian French systems.
- **Transmission Signal Identifier (TSID)**: Indicates if the TSID is present in the SDI stream. If missing, "Not Detected" will display; otherwise, the TSID is displayed as a hexadecimal number.
- **Copy Generation Management System-Analog (CGMS-A)**: Indicates if the CGMS-A is present in the signal. If missing, "Not Detected" will display; otherwise, the CGMS-A value is displayed.
- **Broadcast Flag**: Indicates if a broadcast flag was detected or not.
- **Timecode (TC) Flags**: Indicates the timecode status. The drop frame (DF) is 0 when drop frame compensation is being performed normally. DF is 1 when the count is not drop frame compensated. The color frame (CF) status is 0 when there is no relationship between the CF sequence and the time address. CF is 1 when CF ID is applied to the time address. Support for measuring timecode discontinuities and Jog/Shuttle detection.
- **Pol**: Indicates the biphase polarity correction.
- **BG Flags**: Indicates the binary group (BG) values and whether they are specified. The readout will display a number from 0 to 7. For example, bit 0 is BGF0, bit 1 is BGF1, and bit 2 is BGF2.
- **BG Data**: Indicates the binary group (BG) data value.
- **Wide Screen Signaling (WSS)**: Indicates if the WSS is present. The supported formats include Composite PAL and 625-line SD. The WSS data is displayed with the hexadecimal byte value and its description. WSS decoding conforms to standard ITU-BT.1119-2.
- **Active Format Description (AFD)**: Indicates if the SMPTE 2016-1 and 3 Format for Active Format Description and Bar Data is present. The AFD data is displayed with the hexadecimal byte value and its description. AFD decoding conforms to standard SMPTE 2016 1-3.
- **Video Index Scanning B2-B0**: Shows the Video Index Scanning System information. Conforms to SMPTE RP186-2008 Class 1.1. Data Octet 1. Scanning System provides information about the total number of lines, field rate, and aspect ratio.
- **Video Index AFD/ARD B6-B3**: Shows the Video Index binary value of Bits 6 to Bits 3 that are used to define the Active Format Descriptor. Conforms to SMPTE RP186-2008 Class 1.1. or ARDSPEC 1. See the instrument online help for a detailed description of codes: while the Aux Data Status display is active in a tile, press the HELP button.

Dolby Status

When your instrument is equipped with Option AUD, you can view Dolby metadata from the currently monitored SDI input. You can view Dolby VANC data (SMPTE 2020) from the Dolby Status Display. (See Figure 32.)

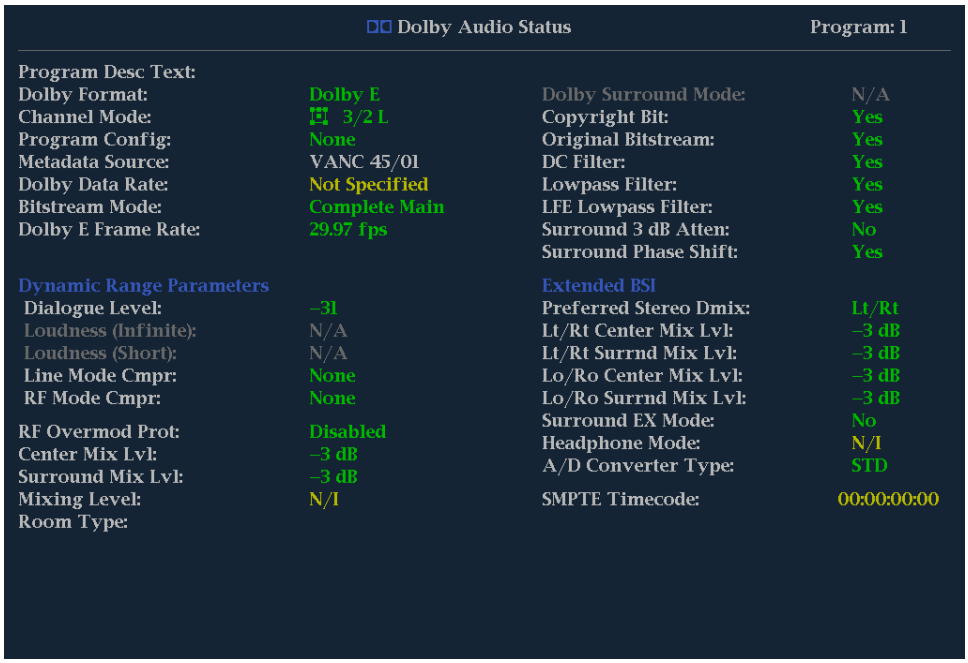


Figure 32: Dolby Status display

Elements of the Dolby Status display. The following is a list of some of the elements that show on the Dolby Status display. Some elements apply only to Dolby type E. If Dolby type D is detected, these elements display with their names grayed out and with a value of N/A. For a complete list of the elements that might appear, see the instrument online help by pressing the **HELP** button when the Dolby Status display is active in a tile.

- **Program Description Text**: A 32-character ASCII text field used by the program author to describe the audio program; for example, the name of the program (Movie Channel Promo), the program source (Football Main Feed), or the program language (Danish).
- **Dolby Format**: Indicates the Dolby Format. This indicator is also tied to the Dolby Format Error/Alarm: if the Alarm is asserted, the Dolby Format is displayed in red.
- **Channel Mode (or Audio Coding mode)**: Indicates the active channels within the encoded bit stream, representing it in a ratio, X/Y, where X is the number of front channels (Left, Center, Right) and Y is the number of rear (Surround) channels. If the LFE Channel is present, an L is appended at the end of the channel mode.

- **Program Configuration**: Determines how the audio channels are grouped within a Dolby E bitstream. Up to eight channels can be grouped together in individual programs, where each program contains its own metadata.
- **Dolby Source**: Indicates the instrument input from which the Dolby Content is sourced.
- **Dolby Data Rate**: For Dolby D, indicates the encoded data rate; for Dolby E, indicates the data rate that would be used to encode a Dolby Digital bitstream.
- **Dolby Sample Rate**: Indicates the sample rate of the decoded Dolby Digital bitstream.
- **Bitstream Mode**: Describes the audio service contained within the Dolby Digital bitstream. A complete audio program may consist of a main audio service (a complete mix of all the program audio), an associated audio service comprising a complete mix, or a main service combined with an associated service. For more information about possible values, see the instrument online help; when the Dolby Status display is active in a tile, press the HELP button.
- **Dolby E Frame Rate**: Indicates the Dolby E frame rate. If Dolby Frame Rate is not the same as the video Frame Rate, the rate value is displayed in red.

ARIB Status

Check for the presence and status of ARIB-based information encoding. The instrument supports TR-B.22, TR-B.23-1, TR-B.23-2, B.35, B.37, and B.39 ARIB standards. To view the ARIB content displays, enable this option in **CONFIG > Aux Data Settings > ARIB Content Display**. For detailed information about ARIB displays, go to the *ARIB Displays* section in this manual. (See page 99.)

Audio Display

Pressing the **AUDIO** button brings up the Audio Display if the instrument has Option AUD installed. This display provides level meters and a phase display for monitoring audio signals. The Audio display always shows the level meters and correlation meters. When you choose to display the Phase plot (also known as Lissajous) or Surround Sound, the left part of the Audio tile displays the level meters and the right part the Phase or Surround Sound display. You can also view Dolby E timing in this display. (See Figure 33.)

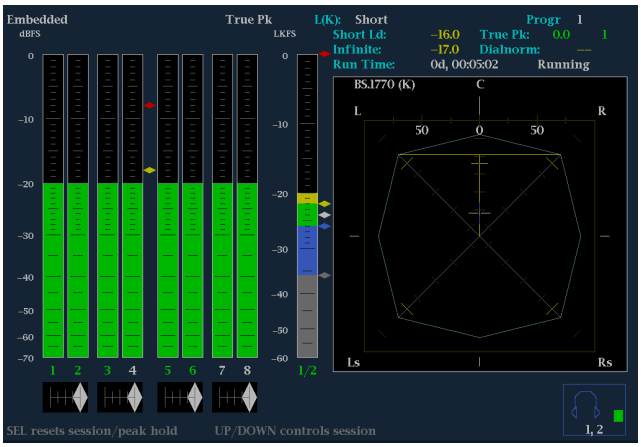


Figure 33: Audio display

Elements of the Audio Display

- **Level meters**: Shows the audio levels. (See page 116, *To Check Audio Level*.)
- **Loudness meter**: This meter is configured in the **CONFIG** > **Loudness Settings** menu. Once configured, enable it by pressing and holding the **AUDIO** button to get the pop-up menu. The following indicators appear next to the meter and show the loudness:
  - **Gray diamond**: indicates Too Quiet loudness threshold
  - **White diamond**: indicates Target Loudness threshold
  - **Blue diamond**: indicates target loudness low threshold
  - **Yellow diamond**: indicates target loudness high threshold
  - **Red diamond**: indicates Too Loud loudness threshold
  - **Loudness channel**: appears at the base of the loudness meter and shows which channels are being displayed. If **Program** is selected, the channel label will be **P1** up to **P8**. The channel text is green if the channels are set to Program.
- **Phase, Surround, or Loudness Display**: Select between the Phase display, where the phase of a selected pair of channels is plotted against an X-Y or sound-stage plot, the Surround display, where all the channels' levels display

in positions matching their place in a surround-sound listening environment, and the Loudness display, where loudness targets are shown. (See page 117, *To Check Audio Phase*.) (See page 120, *Elements of the Surround Sound Display*.) (See page 60, *Audio Loudness Session*.)

- **Audio source/setup**: Displays the selected audio input and related setup information, such as Listening Mode when in Surround display. (See page 115, *Audio Monitoring*.)
- **Level meter labels**: Identifies the signal in each meter bar. The labels vary according to whether the audio sources to the level meter bars are normal channel pairs, surround channels, or Dolby sources (the Dolby source labels include Dolby type).
- **Level meter ballistics readouts**: Displays the selected dynamic response characteristic.
- **Axes**: Shows the orientation of the two audio signals when displaying phase; shows the orientation and amplitudes of the sound field when displaying surround sound. (Axes are selectable for an X-Y or Soundstage plot.)
- **Phase correlation meters**: Displays the phase correlation between the two-channel bars under which it appears. The meter of the pair selected for the Phase display also appears in the Phase display. (See page 117, *To Check Audio Phase*.)
- **Test level and Peak program level indicators**: Diamond-shaped markers between the level bars indicate the configurable limits set up for the display. Above the Test level, the bar displays in a yellow color. Above the Peak level, the bar displays in a red color. Test level is also known as Reference level or Line-up level.
- **Level meter scale and units**: By default, the units are in dB relative to full scale (dBFS) for digital inputs and dB relative to 0.775 Volts (dBu) for analog inputs. The 0 dB mark is digital Full scale for digital inputs and 0 dBu for analog inputs. You may also set the 0 dB mark to either the Peak Program level or the Test level. See also CONFIG > Digital Audio Displays > Set Meter Type To, and CONFIG > Analog Audio Displays > Set Meter Type To.

NOTE. *The loudness measurement supports three types of filters: Flat, A-weighted, and RLB (ITU-R BS.1770). You can view the measurement in the Audio Session display and configure it from the Audio pop-up menu.*

Above-Bar Warning Messages

This instrument displays warning messages above the level meter bars. The warning messages that can appear above the bars as follows:

- **Clip**. The number of consecutive samples equals or exceeds the # Samples for Clip setting.
- **Over**. The signal is at or above the specified Over Level for a time exceeding the Duration for Over setting.

In-Bar Warning Messages

This instrument displays warning messages within the level meter bars. The warning messages that can appear are shown below in order of priority.

- **UNLOCKED**. The instrument is not locked to an incoming signal on the indicated input channel. Data cannot be decoded and all data and other errors are ignored. This means that if embedded audio is selected, the VIDEO input is unrecognizable.
- **AES PARITY.** The incoming subframe does not have even parity as specified by the digital audio standards. The data sample is unreliable and is ignored. The level meters and Lissajous display treat the sample as a zero sample.
- **AES CRC ERROR.** The CRC code in the AES channel status packet is incorrect. Sometimes the CRC code is set to zero, indicating that the signal is missing; when this is the case, this message is not displayed.
- **MUTE.** The number of consecutive all-zero samples equals or exceeds the # Samples for Mute setting.
- **SILENCE.** The signal is at or below the specified Silence Level for a time exceeding the Duration for Silence setting.
- **DISABLED.** Indicates that an audio bar is not active. This message is mainly seen with a Dolby Digital source when a listening mode is selected with a reduced number of channels.
- **AES V BIT.** Indicates that the Validity bit is set high for one or more data samples. In the AES/EBU standard, a set validity bit indicates that the sample is not suitable for conversion to audio. By default, the level meter bars and Lissajous display treat the affected samples as zero samples.
- **NO AUDIO.** Indicates that an embedded input has the Non audio bit set.
- **NOT PRESENT.** Indicates that an audio bar is not present in the current audio input. This can be present if a Dolby Digital input has a coding mode indicating a reduced number of channels.
- **DOLBY D+.** Indicates an embedded input is DOLBY Digital Plus.
- **DOLBY E.** Indicates an embedded input is DOLBY E.

Audio Display Pop-Up Menu

The Audio pop-up menu enables you to select the audio input source and specify whether a phase display or a surround-sound displays appears in a subtile to the right of the level meter display.

To select the source for the Audio display, select **Audio Input** in the menu and set a source. The number of available sources depends on which audio option is installed. Choosing any given input will make that audio the monitored signal regardless of which video input is active. Alternatively, choose Follows Video to enable the mapping that allows changing the audio source as the video input selection is changed.

NOTE. *Use the CONFIG menu to select the mapping of input to bar, the meter type, and the Follows Video mapping of audio to video.*

Headphone input maps audio pairs to the front panel headphone jack.

Analog Out Atten is used to adjust the levels to the rear panel analog outputs.

To add a 2-channel phase display to the audio tile, set **Aux Display** to **Phase Display** in the Audio pop-up menu. A phase display is also called a "Lissajous" display.

To choose the plot style of the Phase Display, select between the following two entries in the pop-up menu:

- Sound Stage has axes rotated at a 45 degrees.
- X-Y has axes that are horizontal and vertical.

To choose the pair of inputs that is displayed in the phase display, select **Phase Pair** and set a value. You can also select Custom, and then specify individual channels for the input pair, using the Phase Channel A and Phase Channel B entries.

To define when audio channel pairs are considered out of phase and the **Audio Phase alarm** occurs, you should set the following two parameters:

- **Phase Err Corr**: Defines the percentage of correlation error that must occur before the Audio Phase alarm is triggered.
- **Phase Err Duration**: Defines the duration of time for which the error must occur before the Audio Phase alarm is triggered.

To add a multi-channel surround sound display to the audio tile, set **Aux Display** to **Surround Sound** in the Audio pop-up menu. You can also enable either or both of the following entries:

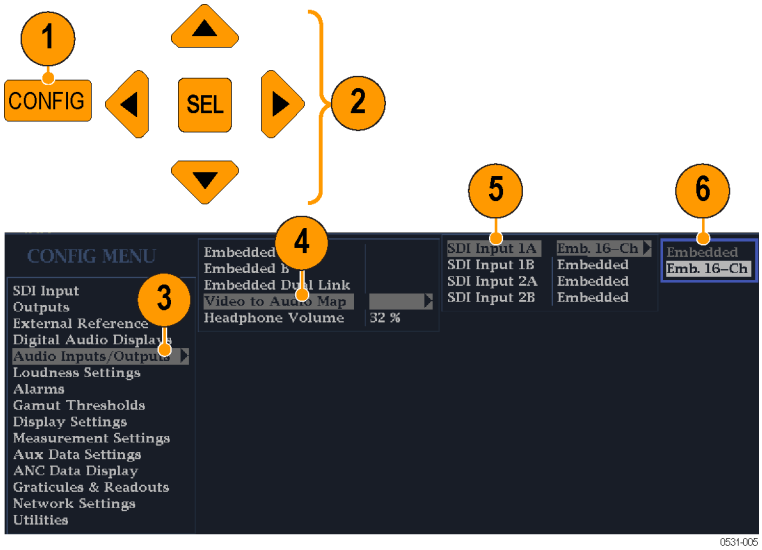
- Dominance Indicator. When on, indicates the location of the dominant sound in the surround sound image using a cross-hairs pointer (surround display only).
- Loudness. When set to Flat, results in a non-weighted response; when set to A-weighted, results in a response that more closely matches that of the human ear.

NOTE. *The Audio Surround Sound display is courtesy of Radio-Technische Werkstaetten GmbH & Co. KG (RTW) of Cologne, Germany. Surround Sound: Radio-Technische Werkstaetten GmbH & Co.*

Configuring Audio Inputs for Embedded 16-Channel Audio

To set up an Audio Input for Embedded 16-Channel audio:

1. Press the **CONFIG** button to display the configuration menu.
2. Use the arrow keys and **SEL** button to make selections in the steps that follow.
3. Select **Audio Inputs/Outputs**.
4. Select **Video to Audio Map**.
5. Select the correct SDI input.
6. Select **Emb. 16-Ch**.
7. To set the appropriate ballistics (True Peak, PPM Type 1, PPM Type 2, or Loudness), see the **Config > Digital Audio Displays** menu.



The following functions are not supported for 16-Channel audio:

- Audio input to bar mapping
- Audio output mapping
- Correlation meters
- Lissajous and phase displays
- Headphone

NOTE. *You cannot modify the input and output mapping because the mappings are fixed for 16-Channel audio.*

Selecting Audio Input for Embedded 16-Channel Audio

1. Select a tile.
2. Press and hold the **Audio** button to open the Audio display in a tile and view the Audio pop-up menu.
3. Select **Audio Input** and then select the **Emb. 16-Ch** option.

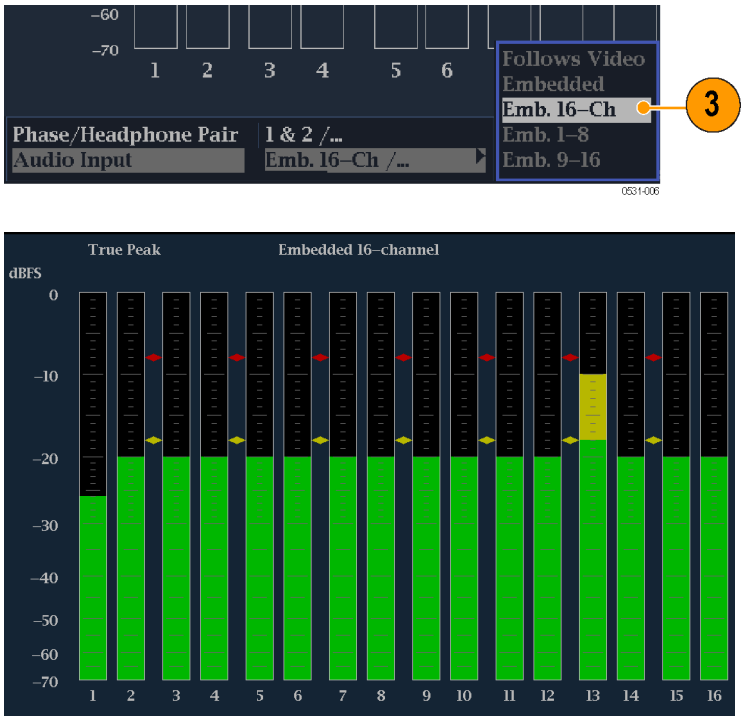
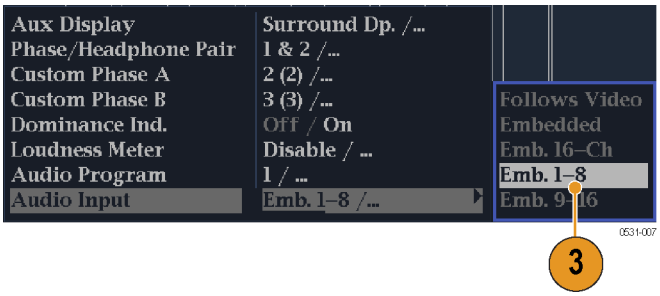


Figure 34: 16-Channel audio bars display

Quick Selection of 1-8 or 9-16 Channels of Embedded Audio

1. Select a tile.
2. Press and hold the **Audio** button to open the Audio display in a tile and view the Audio pop-up menu.
3. Select **Audio Input** and then select **Emb. 1-8** or **Emb. 9-16**.



Picture Display

Pressing the **PICT** button calls up the Picture display, which lets you see the picture generated by the video signal. You can choose to display the picture with or without a Picture Frame, VChip, Closed Captioning (CC), Teletext, and Safe Area Graticules. (See Figure 35.) (See page 123, *Closed Captioning (CC), Teletext, AFD, and Safe Area Compliance*.)

Figure 35: Picture display showing color bars

Elements of the Picture Display

In full-screen mode, there is no cropping. Pictures are decimated horizontally or vertically to obtain the correct aspect ratio. This decimation may cause some artifacts. This behavior may be evident on a sweep signal. Also see the online help for the Picture Aspect Ratio for related information. Display can be set to include Closed Captioning text or Teletext subtitles overlaid on the picture.

The VChip, CC-Display, Teletext, and Safe Area Graticule are described below: (See Figure 36.)

1. **VChip Area:** Displays detected VChip ratings from any of these systems: MPAA (US), TV (US), Canadian English, and Canadian French. VChip information is labeled CA (Content Advisory).
2. **Safe Graticules:** SMPTE, BBC, and ARIB B-4 standards for safe area graticules allow for selection of up to two Safe Area and two Safe Title graticules. Custom graticules with adjustable areas can also be specified.
3. **Closed Caption Text and Teletext Area:** Displays closed captioning or Teletext, configurable to decode to the following Closed Caption and Teletext standards.
   - For Composite: CEA-608-line-21 (VBI), TeletextB VBI (PAL)
   - For SD: CEA-608-line-21, TeletextB VBI (625), CEA-608 (ANC), CEA-608 (708), CEA-708, TeletextB VBI, TeletextB OP47 SDP (ANC), and TeletextB OP47 Multi (ANC)
   - For HD and 3G: CEA-608 (ANC), CEA-608 (708), CEA-708, TeletextB VBI, TeletextB OP47 SDP (ANC), and TeletextB OP47 Multi (ANC)

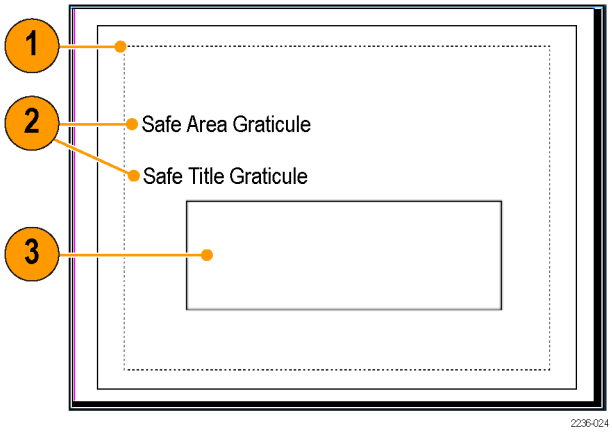


Figure 36: VChip, CC-Display, Teletext, and Safe Area Graticule in Picture display

Picture Display Pop-Up Menu

When monitoring to ensure that branding or other elements do not overlay essential text or video action, use the **PICT** pop-up menu to select a Safe Action and Safe Title graticule. The Safe Action Area is the maximum image area within which all significant action should be contained, and the Safe Title Area is the maximum image area within which all significant titles should be contained. You can select standard or custom safe area graticules.

- **Picture Frame**: Select to turn the picture frame On or Off.
- **CC/Teletext Format**: Select from Off, Auto, CEA608, CEA708, and WST.
- **CEA608 CC Services**: Select from CC Channel 1 through 4 and Txt Channel 1 through 4.
- **CEA708 CC Services**: Select from Service 1 through 6.
- **TtxtB Page**: Select the teletext B page.
- **Safe Area Action 1**: Select from Off, Auto, 4x3, 14x9, 16x9, Custom_1, and Custom_2.
- **Safe Area Title 1**: Select from Off, Auto, 4x3, 14x9, 16x9, Custom_1, and Custom_2.
- **Safe Area Action 2**: Select from Off, Auto, 4x3, 14x9, 16x9, Custom_1, and Custom_2.
- **Safe Area Title 2**: Select from Off, Auto, 4x3, 14x9, 16x9, Custom_1, and Custom_2.
- **Black/Frozen Grat**: Select from Off, Black, and Frozen.
- **AFD Graticules**: Select from ON and Off.
- **Picture Center Grat**: Select from ON and Off.

Functions

Gain, Sweep, and Magnification

Set the gain, sweep mode, and sweep rate using the **GAIN**, **SWEEP**, and **MAG** buttons. A lit front-panel button indicates that the function is active.

NOTE. *Gain, Sweep, and Magnification do not apply to all display types.*

To Set Gain

Use Gain with the WFM, VECTOR, and Bowtie displays.

- Select a trace display.
- Press and hold the **GAIN** button to display the Gain pop-up menu.
- If you enable **VAR Gain**, set the gain using the General knob. If you select **Gain Settings**, choose the gain (x2, x5, x10) of your choice.

After you have set up Gain parameters, you only need to press the **GAIN** button once to activate Gain. Press it again to remove Gain.

To Set Sweep Mode

Use Sweep with the WFM and Bowtie displays.

- Select a trace display.
- Press and hold the **SWEEP** button to display the Sweep pop-up menu.
- Select Line or Field sweep. The available options depend on which display is active. For example, when the WFM Display is in Overlay mode, you can select from either Line or Field. When that same display is in Parade, only Line is available.

After you have set up Sweep parameters, you only need to press the **SWEEP** button once to activate Sweep. Press it again to remove Sweep.

To Set Magnification

Use Magnification with the WFM, VECTOR, and Bowtie displays.

- Select a trace display.
- Press and hold the **MAG** button to display the Magnification pop-up menu.
- Select a magnification setting, such as Best View, x10, x20, x25, or x30. In the Vector displays, the magnification is called H Gain (horizontal gain). The available options depend on which display is active.

After you have set up Magnification parameters, you only need to press the **MAG** button once to activate Magnification. Press it again to remove Magnification.

Cursors

Cursors enable you to measure time or voltage on a waveform. Cursors appear only in a tile set to Waveform mode. If the active tile is not in Waveform mode, then an error message is displayed.

Display and adjust the cursors as follows:

1. Choose a tile that is currently displaying a waveform.
2. Press and hold the **CURSOR** button to display the cursor menu and then select the cursor style you want: **Voltage**, **Time**, or **Voltage + Time**. (After the cursors are activated and the pop-up menu is closed, pushing **CURSOR** again turns the cursors off.)
3. Push the arrow keys to select the active cursor:
   - If Voltage or Time cursors are displayed, press any arrow key to activate a cursor.
   - If Voltage + Time cursors are both displayed, press either the up or down arrow key to select between voltage cursors. Press either the left or right arrow key to select between the time cursors.
4. Turn the **GENERAL** knob to adjust the selected cursor on the waveform. The active cursor readout appears in yellow with a knob icon.

NOTE. *To quickly center the active cursor on screen, press and hold the **SEL** button.*

5. Repeat steps 2 through 4 to adjust the other cursor.

6. Read the cursor measurement in the Cursors readout.

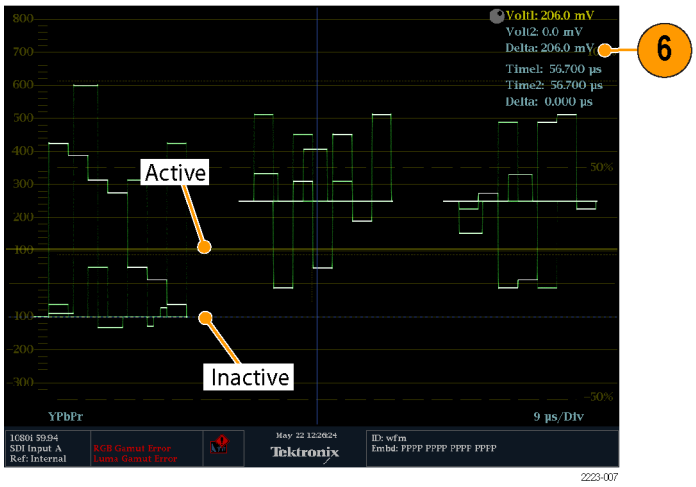


Figure 37: Using cursors in a waveform display

Capture

Use the **CAPTURE** button to freeze a single tile, or all tiles simultaneously, saving it to memory while other displays and information continue to be live. Frozen information is lost when the power cycles.

NOTE. *Freeze information can be downloaded from the instrument Web page.*

Capture freeze works in both four-tile and full-screen modes, however, if you freeze a trace in 4-tile mode, the image will not be shown if you go to full-screen mode. The image will still be available if you go back to 4-tile mode. Likewise, if you freeze a waveform image in a tile and then switch the tile to another measurement such as Vector, the frozen waveform image is hidden. If you then change the tile back to waveform, the image will reappear.

NOTE. *For waveform displays, the captured image is shown in a different color to distinguish it from the live image. For all displays, the instrument continues to log error status in the background while the display is captured.*

Line Select

Line Select allows you to select lines in the waveform display. This function is accessible from the front panel of your instrument by pressing the **LINE SEL** button.

1. Select the tile containing the display for which you want to set Line Select Mode.

NOTE. *Line Select Mode can only be active on one tile at a time, but the line select brightup cursor does appear in other tiles and moves as you select lines in the active tile.*

2. Press the **LINE SEL** button to toggle Line Select Mode on or off. When on, the tile displays the selected line information only.
3. Press the left or right arrow key to select F1 (field 1), F2 (field 2), F3 (field3), F4 (field 4), or All.
4. The line and field information will appear at the bottom of the display screen.
5. Turn the **GENERAL** knob to select the line you want to view.

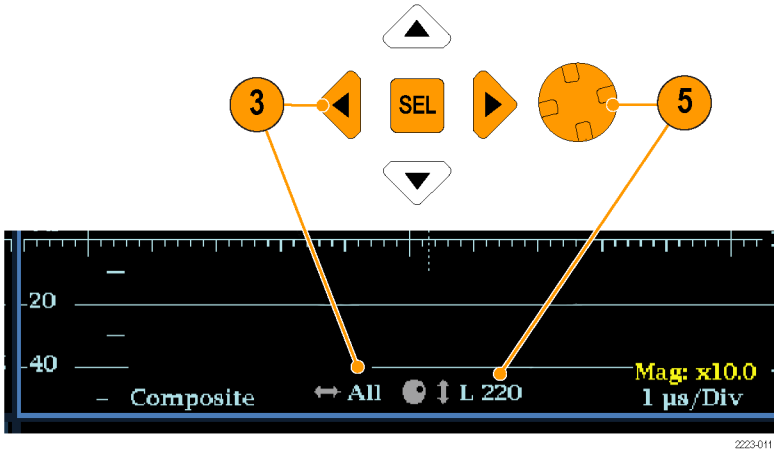


Figure 38: Navigating line selection

Headphone Volume and Source Adjustment

WARNING. *To avoid damaging your hearing, always turn the volume down to the minimum before you put on headphones, and then turn the volume up slowly.*

The headphone jack is located on the front panel of your instrument. You can adjust the volume to the headphones from the Audio menu as follows:

1. Press the **AUDIO** button to show the audio display in a tile.

NOTE. *The headphone icon appears at the bottom of the Audio display.*

2. Use the Horizontal knob to adjust the volume.
3. Adjust the headphone source by pressing the **AUDIO** button, selecting **Headphone Input**, and then selecting the source you want.

You can adjust the master headphone volume from the **Config > Audio Inputs/Outputs > Headphone Volume** menu.

Presets

Instrument setups can become complex as you tailor them to monitor various parameters. To save set up time and ensure consistency, you can save instrument setups as presets in your instrument. Save and quickly access presets from the **PRESET** button on the instrument front-panel and from the instrument Web page.

All instrument settings except those set in the Utilities and Network Settings submenus of the Configuration menu are saved in a Preset. Settings that are not saved are those such as the clock setting, IP configuration, and network address. The following is an overview of the settings saved in a Preset:

- Measurement assigned to each tile
- Tile specific settings
- Input selection
- SDI Input settings
- External Reference settings
- Audio Displays settings
- Audio Inputs/Outputs settings
- Alarm settings
- Gamut thresholds

- Display settings
- Readout setting
- Graticule settings

To Save Presets

The instrument can store up to 32 separate instrument presets. The presets are divided into four groups, A through D, with each group containing 8 preset storage locations. The default preset names are A1 – A8, B1 – B8, C1 – C8, and D1 – D8.

Quick access to presets 1 – 8.

1. Set up the instrument exactly as you want to have it configured. This includes setting the contents of each tile and the audio and video settings.
2. Press and hold one of the preset buttons (1 through 8) to which you want to save the setup.

*NOTE. Pressing and holding a preset button accesses the Group A preset locations by default. You can use the **Bezel Group Select** menu in the Preset menu to change which of the four preset groups are associated with the front panel preset buttons.*

3. In the dialog box that appears, press the right arrow key to highlight the **Continue** box.
4. Press the **SEL** button. A message displays that your preset is saved.

Access to all presets.

1. Set up the instrument exactly as you want to have it configured. This includes setting the contents of each tile and the audio and video settings.
2. Press the **PRESET** button to display the Preset Menu.
3. Use the arrow buttons to navigate to a preset location to save the instrument settings. For example select Save Preset > Select Group B > Save B1.
4. Press the **SEL** button. A message will display that your preset is saved.

To Recall Presets

Recalling presets is easy: press the **PRESET** button to display the Preset Menu. Use the arrow buttons to navigate to the preset that corresponds to the preset you want and press the **SEL** button.

To recall factory presets, press the **PRESET** button to display the Preset Menu. Use the arrow buttons to navigate to **Recall Preset** > **Recall Factory Preset** and then press the **SEL** button.

Importing Presets from a USB Device

You can also save presets to the USB drive so that you can load them onto multiple WFM5200 instruments in your system. To import presets to a USB memory device:

1. Insert a USB memory device into the USB drive located in the front of the instrument. To check that the drive mounted properly, press the **MAIN** button and then press the **SEL** button.
2. Press and hold the **Preset** button to view the Preset menu.
3. Press the down arrow key to select **Import Presets**.
4. Press the right arrow key to access the submenu and then press the up/down arrow keys to navigate to **Select Source**.
5. Press the right arrow key to access the submenu, highlight the USB folder from which you want to import, and then press the **SEL** button.
6. Navigate to the **Select Dest** menu option and use the arrow keys to access the submenu.
7. Navigate to the preset group that matches the source preset group and press the **SEL** button.
8. Press the left arrow key and then the down arrow key and highlight **Copy**.
9. Press the **SEL** button. You should see a pop-up notice that says *Import Complete*.
10. If you do not want to import any other presets at this time, press the **Preset** button to dismiss the menu.
11. Remove the USB memory device from the USB drive.

Exporting Presets to a USB Device

To export presets to a USB memory device:

1. Insert a USB memory device into the USB drive located in the front of the instrument. To check that the drive mounted properly, press the **MAIN** button and then press the **SEL** button.
2. Press and hold the **Preset** button to view the preset menu.
3. Press the down arrow key to select **Export Presets**.
4. Press the right arrow key to access the submenu and then press the up/down arrow keys to navigate to **Select Source**.
5. Press the right arrow key to access the submenu, highlight the Preset Group you what to export to the USB memory device, and then press the **SEL** button.
6. Navigate to the **Select Dest** menu option and use the arrow keys to access the submenu.
7. Select a USB folder if one exists or create a folder by following the instructions for the **Create USB Folder** menu selection.

8. In the same submenu, navigate to the Preset Group that matches the source Preset Group and press the **SEL** button.
9. Press the left arrow key and then the down arrow key and highlight **Copy**.
10. Press the **SEL** button. You should see a pop-up notice that says *Export Complete*.
11. If you do not want to export any other presets at this time, press the **Preset** button to dismiss the menu.
12. Remove the USB memory device from the USB drive.

Software Upgrades

After you have verified that your instrument must have the software upgraded, use the following procedures to upgrade the software.

After obtaining the latest software package, you can upgrade the instrument either using the *USB Software Installation* procedure or the *Network Software Installation* procedure.

Obtain the Latest Software

Download the latest version of software available for your instrument.

1. Use the Web browser on your PC to navigate to the following Tektronix Web site:

   `http://www.tektronix.com/downloads`

2. On the Downloads Web page, search by model number (for example, WFM5200) and filter by software and software type to locate the latest software-upgrade package for the instrument.
3. Download the latest version to your PC.
4. After the software package is downloaded, click the self-extracting archive to extract the following files into a directory of your choice. You should have two file: transfer.exe and firmware.pkg. There may also be a readme.txt file.

USB Software Installation

Use the following steps to upgrade the instrument software using a USB flash drive:

1. Insert the USB flash drive into a USB port (of the PC containing the latest software).
2. On the PC, navigate to the USB flash drive.
3. On the USB flash drive, create a directory named:

   `wfmUpgrd`

NOTE. *To avoid upgrade problems, remove all pre-existing files and directories from the USB flash drive. Be sure to create the WfmUpgrd directory exactly as shown.*

4. Open the directory (from the extracted archive) and copy the firmware.pkg file to the WfmUpgrd directory on the USB flash drive.

   You should have a directory path `wfmUpgrd\firmware.pkg`.

5. Safely remove (eject) the USB flash drive from the PC.
6. Insert the USB flash drive into the USB port on the front panel of the instrument.
7. Check that the USB flash drive is mounted. Press the **MAIN** button and navigate to **USB Status** and press the **SEL** button. A USB Status message is displayed. (If the USB flash drive successfully mounted, you will also see the USB Unmount menu selection. Do not unmount.) Press the **MAIN** button again to dismiss this menu.
8. Press the **CONFIG** button.
9. Navigate to **Utilities** > **System Upgrade** > **Upgrade Options** > **USB Upgrade** and press the **SEL** button.

   If the USB flash drive is properly mounted and the firmware package is detected, the System Software Upgrade form USB window displays.

NOTE. *If the instrument displays a message indicating that a USB storage device containing firmware package was not detected, make sure you have the correct directory path with the firmware package on the USB flash drive.*

In some instances, you may need to use your PC to re-format the USB flash drive and start the process again.

10. Select **Continue** from the upgrade window and press **SEL** to start the software upgrade. (Select Cancel if you do not want to continue with the upgrade.)

WARNING. *To prevent upgrade failure, do not remove the USB flash drive or power off the instrument until the upgrade is complete. The instrument displays messages indicating the upgrade status. The upgrade may take up to 12 minutes.*

11. When the process is complete, a message displays to cycle the power to the instrument.
12. After the instrument finishes restarting, use the Configuration menu to verify the correct software version installed.
13. Press the **MAIN** button and navigate to **USB Unmount** and press the **SEL** button. This electrically unmounts the flash drive so that it can be safely removed from the instrument.

Network Software Installation

Use the following steps to upgrade the instrument software using a network connection:

1. Connect the instrument and PC to your local Ethernet network.
2. Power on the instrument.
3. Assign the instrument an IP address:

NOTE. *The data-transfer utility requires that the instrument be assigned a valid IP address. To allow network access to the instrument, the instrument must be assigned a valid IP address for your network. Network addresses can be assigned either manually or automatically using DHCP. If your network does not use DHCP, you will have to manually enter the address for the instrument. To get a valid IP address, contact your local LAN administrator.*

Alternatively, if you connect the PC directly to the instrument using an Ethernet cable, you can assign the instrument any IP address that is compatible with the IP address of the PC.

   a. Press the **CONFIG** button on the front panel.
   b. Navigate to **Network Settings** > **IP Config Mode**.
   c. Select either **Manual** or **DHCP** as directed by your LAN administrator. Select Manual if you are using an Ethernet cable to connect the PC directly to the instrument.
   d. If you selected Manual mode, enter the IP address, subnet mask, and gateway address as directed by your LAN administrator. You need to

enter only an IP address if you are using an Ethernet cable to connect the PC directly to the instrument.

NOTE. *If you selected DHCP mode, the network automatically assigns the instrument an IP address.*

e. Press the **CONFIG** button on the front panel to close the menus.

4. Prepare the instrument for the software upgrade:

a. Press the **CONFIG** front panel button.

b. Navigate to **Utilities** > **System Upgrade** > **Upgrade Options** > **Network Upgrade**.

c. Press the **SEL** front panel button. This displays the System Software Upgrade window.

5. Perform the software upgrade:

a. On the PC, double-click the **transfer.exe** file to launch the transfer program.

b. Type the IP address or DNS name of the instrument you are upgrading, and then press **Enter**. This starts the software upgrade process.

CAUTION. *To prevent upgrade failure, do not close the transfer.exe window until the transfer utility asks for another IP address.*

When the software upgrade completes, the instrument may reboot.

c. The transfer utility displays done when the software upgrade completes. When the software upgrade completes, the instrument will reboot.

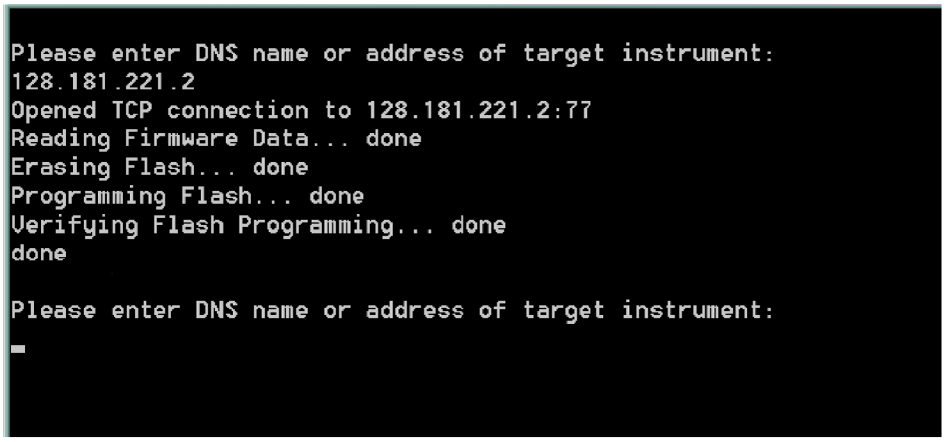

Please enter DNS name or address of target instrument:
128.181.221.2
Opened TCP connection to 128.181.221.2:77
Reading Firmware Data... done
Erasing Flash... done
Programming Flash... done
Verifying Flash Programming... done
done
Please enter DNS name or address of target instrument:

Figure 39: Sample of transfer.exe window after the upgrade is complete

6. If the instrument did not reboot at the completion of the software upgrade, remove and then reapply power to the instrument to cause it to reboot.

Verify Software

1. If the instrument did not reboot at the completion of the software upgrade, cycle the power to the instrument to cause it to reboot.
2. Press the **CONFIG** button on the front panel.
3. Navigate to **Utilities** > **View HW/SW Version**.
4. Verify that the software version number matches the version of the software-upgrade package you installed.

SW Installation Troubleshooting

If a power failure occurs during SW upgrade and the instrument has a blank screen when you reapply power, perform the following procedure.

1. Make sure that an Ethernet cable is connected directly from your PC to the instrument. You need a direct network connection. (See page 6, *Connecting Directly to a PC*.)
2. Turn off the instrument (remove power).
3. Press and hold the left arrow key while you press the power button.
4. The instrument will turn on and the default IP address of 192.168.1.1 will be set.
5. Set the IP address of your PC to 192.168.1.x, where $x \neq 1$.
6. Enter the IP address of the instrument (192.168.1.1) for the upgrade transfer application.
7. Start the upgrade process. When it is complete, the instrument should reboot. If it does not, cycle the power.

If you continue to experience a problem, contact your Tektronix sales representative for assistance.

Checking Chroma/Luma Delay (Lightning Display)

The Lightning display can be used for interchannel timing measurements. If the color-difference signal is not coincident with luma, the transitions between the color dots will deviate from the center mark of a delay scale. The amount deviated represents the relative signal delay between luma and the color-difference signal.

1. Connect a signal containing color bar information to an input on the rear panel.
2. Select a tile to view the Lightning Display, then press and hold the **VECTOR** button.
3. In the Vector pop-up menu, select **Lightning** for the **Display Type**.
4. Set **Bar Targets** to match your input signal.
5. Select **Center Waveform** and press the **SEL** button to center the waveform.
6. Press the **VECTOR** button to close the pop-up menu.
7. Determine where transitions intersect the delay scales and derive the timing error in nanoseconds, as deflected from the center mark, using the following guidelines. (See Figure 40.)
   - The center mark of the nine marks spanning each green-magenta transition is the zero error point.
   - Alignment to a mark toward black means the color-difference signal lags with respect to luma.
   - Alignment to a mark toward white means the color-difference signal leads the luma signal.
   - The upper half of the display measures the Pb to Y timing; the bottom half measures the Pr to Y timing.

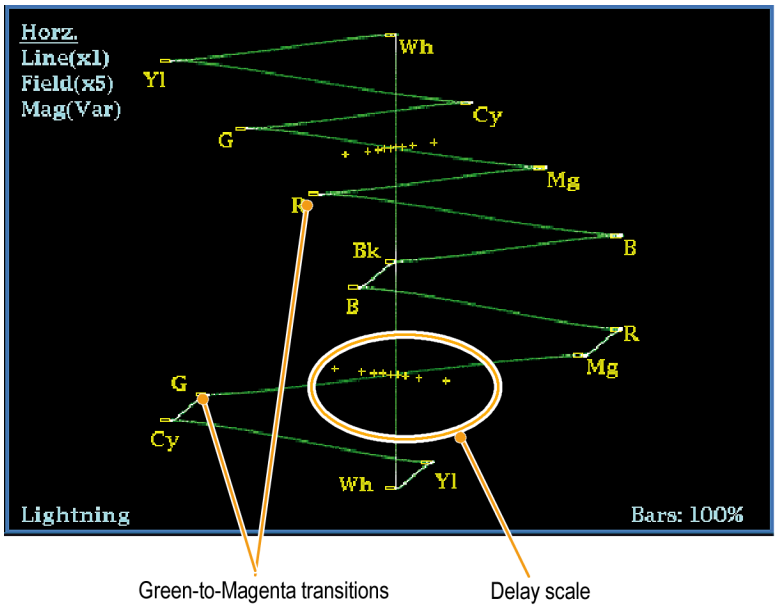


Figure 40: Determining transition intersections in the Lightning display

The + tic marks on the graticule indicate the following timing errors:

Tic mark	SD Timing error (ns)	HD Timing error (ns)	1080p 50, 59.94, 60, 3Gbps (3 Gb/s and dual link formats) Timing error (ns)
0 marks	0	0	0
1st	20	2	1
2nd	40	5	2.5
3rd	74 [1]	13.5	6.75
4th	148 [2]	27	13.5

[1] Luma sample

[2] Chroma sample

Checking Gamut

Signals that are legal and valid in one signal representation may not be legal in another representation. Specifically, signals which are legal in the Digital YCbCr representation may not be legal if transcoded to RGB or encoded to NTSC / PAL. Any signal that fails this test is considered out of gamut.

Adjust Gamut Thresholds from the Configuration menu. From this same menu, you can also reset some gamut thresholds to default values.

Your instrument supports multiple displays and alarms to detect out-of-gamut signals. The flexible, tiled display allows you to simultaneously view several gamut measurements to learn which is most appropriate for a given application. The displays are and their uses follow:

- Diamond for checking that SDI signals conform to legal RGB gamut space.
- Split Diamond separates the upper and lower diamonds to show excursions below black; otherwise it is identical to the Diamond display.
- Arrowhead for checking if an SDI signal is legal for composite color space.
- Composite Waveform modes for checking video signals for legality in composite color space.
- Spearhead for showing lightness, color value, and saturation of the RGB color space.

Diamond, Split Diamond, Arrowhead, and Spearhead have adjustable thresholds. If the signal goes outside the area defined by the thresholds, the signal is out of gamut. If these limits are exceeded, then the instrument can generate alarms if configured to do so. For composite waveforms, the legal limit is simply the maximum level allowed for the combination of luma and chroma. This limit depends on the application. For example, a video tape machine may be able to record and play out signals with higher luma and chroma components than a transmitter.

To Set Up Gamut Checks

1. Connect a video signal to an SDI input on the rear panel.
2. Select a tile in which to view the Gamut Display and press and hold the **GAMUT** button.
3. In the Gamut pop-up menu, select from the following gamut display types:
   - Diamond – Use to detect, isolate, and correct RGB component gamut errors. (See page 94, *Checking RGB Gamut*.)
   - Split Diamond – Use to reveal hard-to-find black gamut errors.

- Arrowhead – Use to detect composite gamut errors, without employing a composite encoder.
- Spearhead – Use to detect RGB gamut errors.

4. Press the **GAMUT** button to dismiss the pop-up menu.
5. Press the **CONFIG** button and select **Gamut Thresholds**.
6. Set the thresholds as desired.

Checking RGB Gamut

The Diamond and Spearhead displays effectively show how the R, G, and B signals relate. The Diamond display is a good tool for detecting gamut errors. Spearhead requires Option PROD.

To form the Diamond display, the instrument converts the Y, P_b, and P_r components recovered from the serial signal to R, G, and B. To predictably display all three components, they must lie between peak white, 700 mV, and black, 0 V.

For a signal to be in gamut, all signal vectors must lie within the G-B and G-R diamonds. Conversely, if a signal vector extends outside the diamond, it is out of gamut. The direction of an excursion out of gamut indicates which signal is excessive. Errors in green amplitude affect both diamonds equally, while blue amplitude errors affect only the top diamond and red errors affect only the bottom diamond. (See Figure 41.)

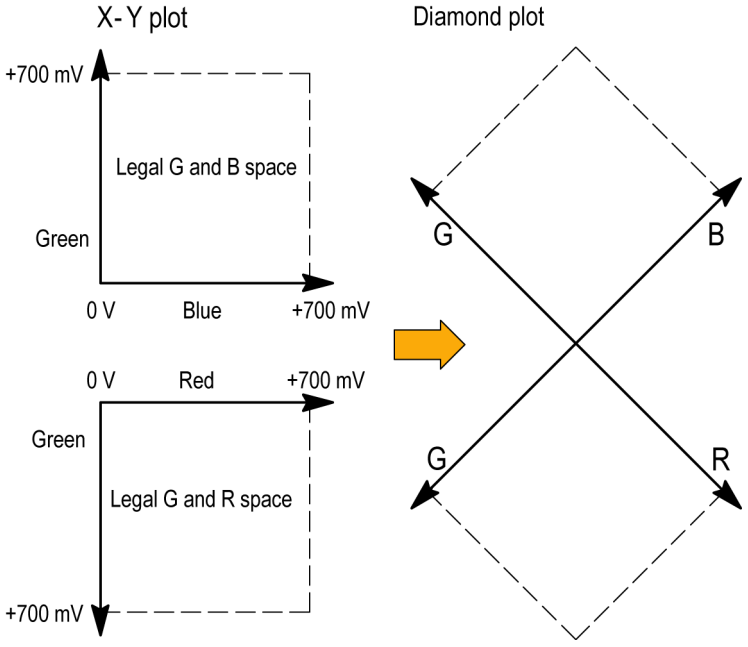


Figure 41: Diamond display plot

Set the thresholds for gamut. (See page 93, *To Set Up Gamut Checks*.) After selecting the **Diamond** display, compare the signal to the display to determine out-of-gamut components. Note the following:

- The intensity of a vector indicates its duration.
- A momentary out-of-gamut condition appears as a faint trace. Long duration violations show as a bright trace.

When evaluating out-of-gamut components, consider the following examples. (See Figure 42.)

- Example A:
  R - Ok
  G > 700 mV
  B - Ok
- Example B:
  R - Ok
  G - Ok
  B > 700 mV
- Example C:
  R - Ok
  G - Ok, 350 mV
  B < 0 mV

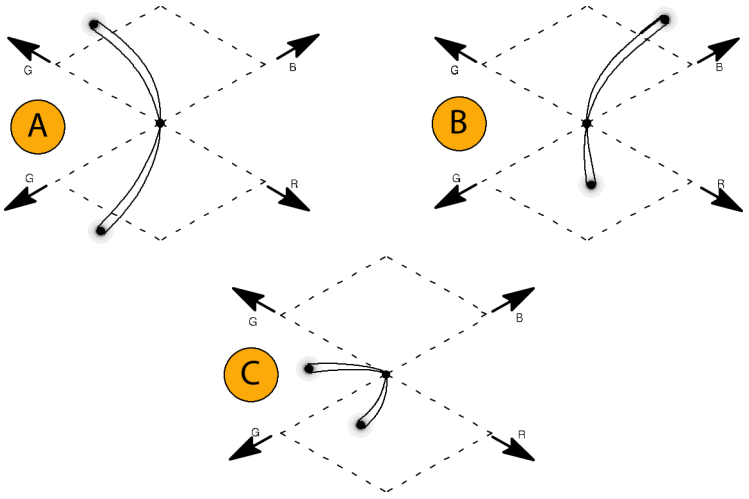


Figure 42: Out-of-gamut examples

Usage Notes

As with the lightning display, bending of the transitions indicates timing delays. When a color bar signal is applied, the vertical axis becomes an indicator of delay errors.

On the Diamond display, monochrome signals appear as vertical lines. Nonlinear component processing, such as from a gamma corrector that alters white balance, can cause deviations along the vertical axis.

To isolate gamut bright-ups, try the following:

- Use the **LINE SEL** button to select individual lines.
- Use the **PICT** display to examine the signal (turn on gamut bright-ups in the Display Settings submenu of the Configuration menu).
- Use the **Diamond Area** or **Arrowhead Area** settings (found in the Gamut Thresholds submenu of the Configuration menu) to specify a percentage of the image pixels to ignore for gamut violations. The Gamut bright-ups, however, will continue to indicate all Gamut violations.

Checking Composite Gamut

The Arrowhead gamut display plots luminance (Y) against chrominance (C) to check if the composite signal adheres to standard gamut. NTSC and PAL Arrowhead displays (75% Color bars) and indicates the values of the graticule lines. The arrowhead shape of the graticule results from overlaying the standard limits for luminance and luminance-plus-peak chrominance. (See Figure 43.)

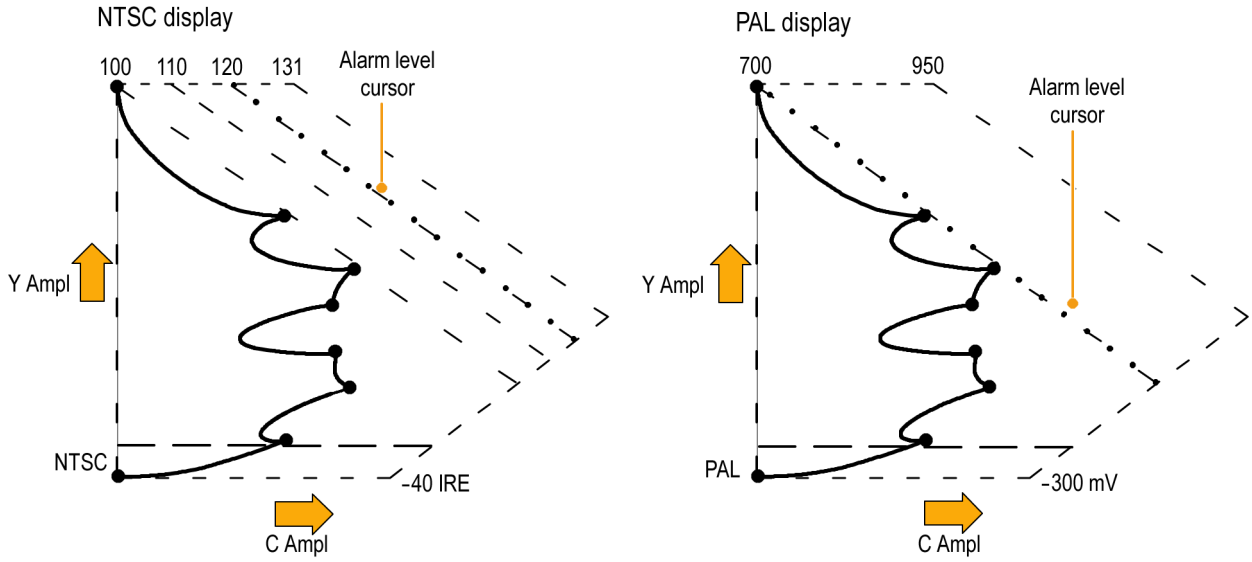


Figure 43: Arrorwhead gamut display plots

Set the thresholds for gamut. (See page 93, *To Set Up Gamut Checks*.) After selecting the **Arrowhead** display, compare the signal to the display to determine out-of-gamut composite components. Note the following:

- Signals exceeding the luminance amplitude gamut extend above the top horizontal limit (top electronic graticule line).
- Signals exceeding the luminance plus peak chrominance amplitude gamut extend beyond the upper and lower diagonal limits.
- The bottom horizontal line shows the minimum allowed luminance level. 0 or 7.5 IRE for NTSC and 0 mV for PAL.

Usage Notes

To automate this check, do the procedure *Automating Gamut Checks*. (See page 97.)

Checking Luma Gamut

Luma limit thresholds can be configured for identifying luma exceeding threshold limits. They apply to both the incoming SDI and to the Arrowhead representation of the SDI input as a composite signal. By defining these levels in percent, they automatically account for the presence or absence of setup. The thresholds are affected by your choice of set-up or no set-up for the Arrowhead display.

Set the thresholds for gamut. (See page 93, *To Set Up Gamut Checks*.) After selecting the **Arrowhead** display, compare the signal to the display to determine out-of-gamut luminance. Note the following:

- The adjustable thresholds are indicated by the dark blue horizontal graticule lines.
- The thresholds are defined in terms of percent of full scale.
- The range for the Upper limit is 90% to 108%.
- The range to the Lower Limit is –6% to +5%.

Another useful Arrowhead function is a measure of how well the active video signal is using the dynamic range of the video channel. A properly adjusted signal should be centered in the arrowhead graticule and have transitions that approach all the limits.

Automating Gamut Checks

You can use alarms to automatically monitor for out-of-gamut conditions.

1. Check that Gamut thresholds are configured as you want them. (See page 93, *To Set Up Gamut Checks*.)
2. Press the **CONFIG** button to display the Configuration menu.

3. Select **Alarms** and then **Video Content**. A dialog box appears where you can select for the various Video Content alarms.
4. Use the up/down arrow keys to move to each of the alarms that you want to set. Press the **SEL** button to toggle the alarm on (X) or off.
5. When you have configured the Alarms as you want them, move to the **Select here** box and select it.
6. Back in the Alarms menu, check that **Enable Alarms** is set to **On** before exiting the Alarms menu.

ARIB Displays

Your instrument supports conformance to ARIB data standards contained in the signal source. You will need to enable the ARIB displays from the Configuration menu in the Aux Data Settings submenu. ARIB information is contained in the following status screen displays:

- ARIB Status
- ARIB STD-B.39 Display
- ARIB STD-B.37 Display
- ARIB STD-B.35 Display
- ARIB TR-B.23 (1) Display
- ARIB TR-B.23 (2) Display
- ARIB TR-B.22 Display

The following DID and SDID values are defined for common types of ARIB-compliant data.

DID and SDID values for common ARIB data types

Ancillary data type	DID value	SDID value
ARIB TR-B.22, Sub Information of transmitting materials	0x5F	0xE0
ARIB TR-B.23, Line 20 User Data - 1	0x5F	0xFC
ARIB TR-B.23, Line 20 User Data - 2	0x5F	0xFB
ARIB STD-B.35 Trigger Signal for Data Broadcasting	0x5F	0xFD
ARIB STD-B.37 Closed Captioning		
Analog signal	0x5F	0xDD
SD signal	0x5F	0xDE
HD signal	0x5F	0xDF
ARIB STD-B.39 Inter Stationary Control Data		
ARIB specification	0x5F	0xFE
ITU specification	0x43	0x01

ARIB Status

The ARIB Status display is a status summary screen for the signal. (See Figure 44.)

Figure 44: ARIB Status display, showing no data present

Use the ARIB Status display with the other specific ARIB Display screens to quickly determine if the data you are interested in is present in the signal. If the data is present, use the STATUS > ARIB Display menu to select the specific ARIB data packet type to view.

The ARIB Status display shows the presence (or absence) of each of the following supported standards (STD) or technical reports (TR):

- Transmitting station code (unique identification code of the transmitting station).
- Transmitting station time (time of broadcast from the transmitting station).
- ARIB STD-B.39 (inter-stationary control data).
- ARIB STD-B.37 (closed caption data).
- ARIB STD-B.35 (trigger signal data).
- ARIB TR-B.23 (1) (guidelines for inter-stationary control data transport, group 1).
- ARIB TR-B.23 (2) (guidelines for inter-stationary control data transport, group 2).
- ARIB TR-B.22 (guidelines for ancillary data transport).

Also, the status of the following ITU standard is shown:

- ITU.R BT-1685 (inter-stationary Control Data conveyed by ancillary data packets).

ARIB STD-B.39 Display

The ARIB STD-B.39 display shows the decoded data for video signals using ancillary data compliant with ARIB STD-B.39. (See Figure 45.) When this display is selected, the instrument searches the signal for ARIB STD-B.39 packets using the DID/SDID combinations defined by either the ITU or ARIB standards organizations.

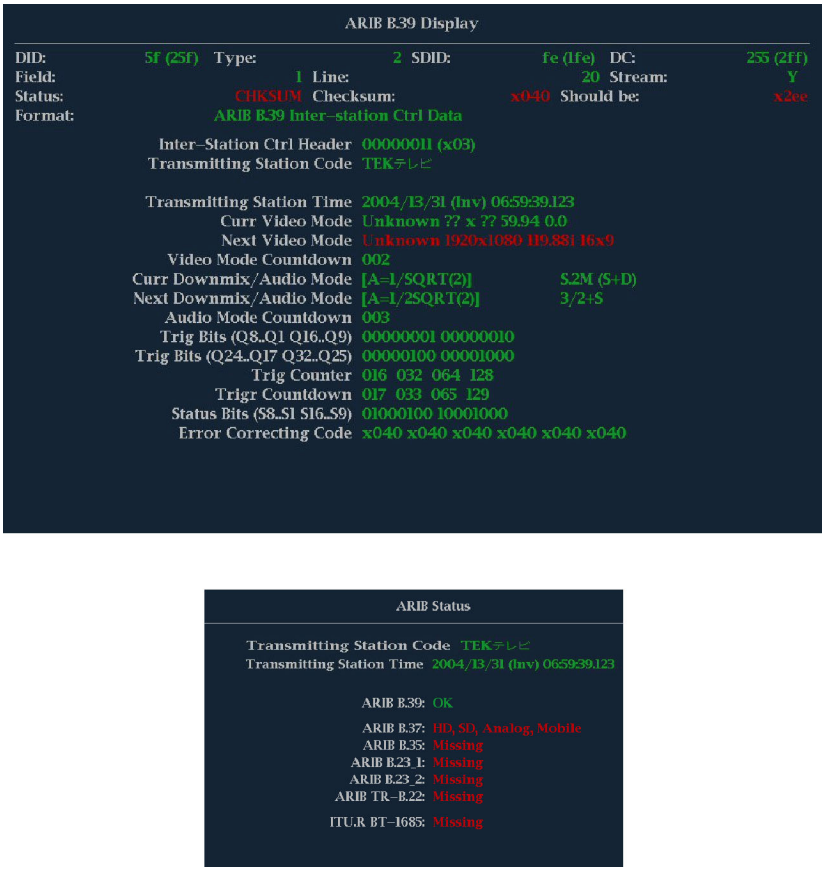

ARIB B.39 Display
DID: 5f (25f) Type: 2 SDID: fe (1fe) DC: 255 (2ff)
Field: 1 Line: 20 Stream: Y
Status: CHKSUM Checksum: x040 Should be: x2ee
Format: ARIB B.39 Inter-station Ctrl Data
Inter-Station Ctrl Header 00000011 (x03)
Transmitting Station Code TEKテレビ
Transmitting Station Time 2004/13/31 (Inv) 06:59:39.123
Curr Video Mode Unknown ?? x ?? 59.94 0.0
Next Video Mode Unknown 1920x1080 119.88 16x9
Video Mode Countdown 002
Curr Downmix/Audio Mode [A=1/SQRT(2)] 5.2M (5+D)
Next Downmix/Audio Mode [A=1/2SQRT(2)] 3/2+S
Audio Mode Countdown 003
Trig Bits (Q8..Q1 Q16..Q9) 00000001 00000010
Trig Bits (Q24..Q17 Q32..Q25) 00000100 00001000
Trig Counter 016 032 064 128
Trigr Countdown 017 033 065 129
Status Bits (S8..S1 S16..S9) 01000100 10001000
Error Correcting Code x040 x040 x040 x040 x040 x040
ARIB Status
Transmitting Station Code TEKテレビ
Transmitting Station Time 2004/13/31 (Inv) 06:59:39.123
ARIB B.39: OK
ARIB B.37: HD, SD, Analog, Mobile
ARIB B.35: Missing
ARIB B.23_1: Missing
ARIB B.23_2: Missing
ARIB TR-B.22: Missing
ITU.R BT-1685: Missing

Figure 45: ARIB STD-B.39 display (with the associated ARIB Status display)

The decoded ancillary data includes the following:

- DID - Data Identifier of the requested inter-stationary control packet; can be any of the following:
  - ARIB specification - 0x5F
  - ITU Specification - 0x43
- Type - Type of the ANC Data packet. For ARIB B.39, this is always a Type 2 packet (DID less than 0x80), as defined by SMPTE 291M. The actual value (with parity bits added) is displayed in parentheses.
- SDID - Secondary Data Identifier of the requested interstationary control packet; can be any of the following:
  - ARIB specification - 0xFE
  - ITU Specification - 0x01
- Line - The line of the video (within the field) from which the packet was acquired.
- Stream - For HD (SMPTE 292M), indicates whether the ancillary packet was acquired from the Y or C data streams. For SD, N/A is displayed.
- Status - Indicates whether packet(s) of the desired type are present in the video; also indicates Checksum or CRC errors.
- Checksum - Indicates the checksum word that was recovered from the acquired packet.
- Should be - Indicates the checksum word computed by the instrument, based on the packet data.
- Format - Indicates the name of the ancillary data type or standard.
- Inter-Station Ctrl Header - A header byte indicating packet continuity, and the presence or absence of the error correcting code.
- Transmitting Station Code - The name of the transmitting station. The instrument supports the display of Japanese characters.
- Transmitting Station Time - The broadcast time at the transmitting station.
- Current Video Mode - The video format of the current program.
- Next Video Mode - The video format of the next scheduled programming.
- Video Mode Countdown - A countdown timer indicating an upcoming change in video mode, which counts down from 254 (0xFE). A value of 0xFF indicates that no format change is pending within the next several seconds.
- Current Downmix/Audio Mode - Indicates the audio downmix and soundstage configuration of the current program.

- Next Downmix/Audio Mode - Indicates the audio downmix and soundstage configuration of the next scheduled program.
- Audio Mode Countdown - A countdown timer indicating an upcoming change in audio mode, which counts down from 254 (0xFE). A value of 0xFF indicates that no format change is pending within the next several seconds.
- Trigger Bits (Q8..Q1 Q16..Q9) - Together with trigger bits Q24..Q17 Q32..Q25, 32 bits that can be used to indicate changes in the program; usage is user-defined.
- Trigger Bits (Q24..Q17 Q32..Q25) - Together with trigger bits Q8..Q1 Q16..Q9; 32 bits that can be used to indicate changes in the program; usage is user-defined.
- Trigger Counter - Increments when bits Q1-Q4 go from 0 to 1. Wraps from 254 (0xFE) to zero. Value of 0xFF indicates the trigger counter is not used.
- Trigger Countdown - A countdown timer indicating an upcoming change in trigger bits Q1-Q4, which counts down from 254 (0xFE). A value of 0xFF indicates that no format change is pending within the next several seconds.
- Status Bits (S8..S1 S16..S9) - 16 user-defined status bits.
- Error Correcting Code - A six-word, Reed-Solomon error correcting code, which is used to verify the integrity of the ARIB B.39 or ITU-R BT.1685 packet.

ARIB STD-B.37 Display and Status Screens

The ARIB STD-B.37 display shows the decoded data for video signals using ancillary data compliant with ARIB STD-B.37. (See Figure 46.) When this display is selected, the instrument searches the signal for ARIB STD-B.37 packets using the DID/SDID combinations defined by ARIB.

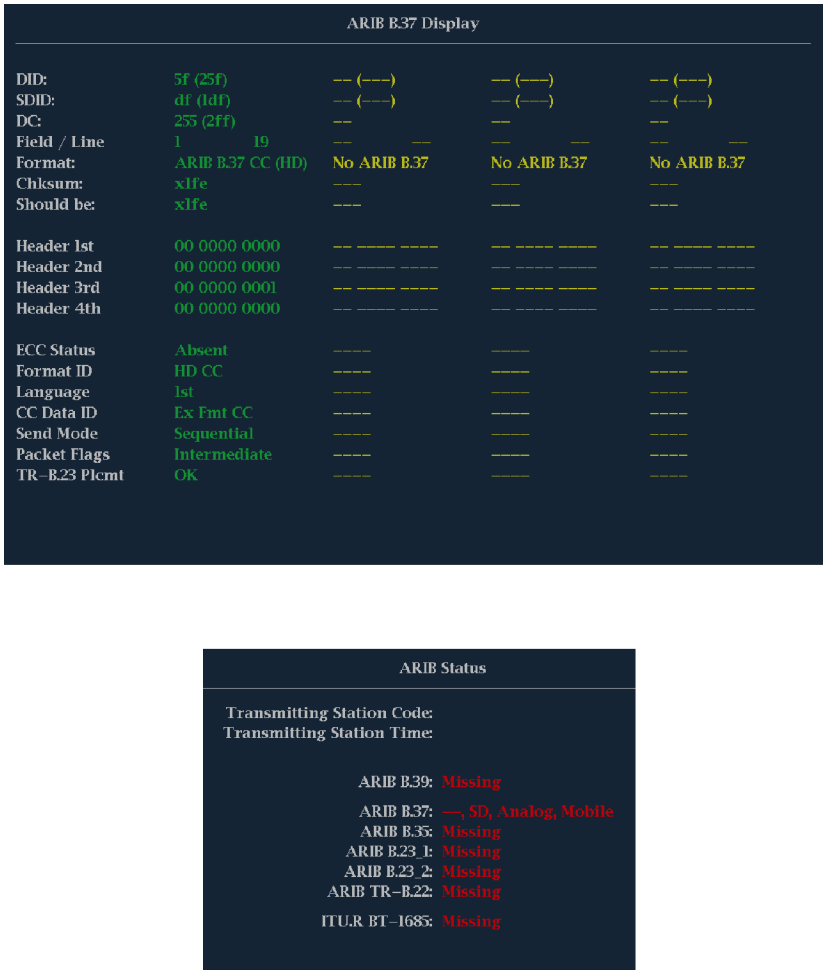


Figure 46: ARIB STD-B.37 display (with the associated ARIB Status display)

The decoded ancillary data includes the following:

- DID - Data Identifier of the requested closed captioning packet; can be any of the following:
  - Analog signal - 0x5F
  - SD Signal - 0x5
  - HD Signal - 0x5F
- SDID - Secondary Data Identifier of the requested packet; can be any of the following:
  - Analog signal - 0xDD
  - SD Signal - 0xDE
  - HD Signal - 0xDF
  - Mobile signal - 0xDC
- Field/Line - The field or line of the video from which the packet was acquired. Displays 1 for progressive formats.

NOTE. *The Line field turns red if the ARIB B.37 packets are not on the line as defined by ARIB TR-B.23.*

- Format - Indicates the name of the ancillary data type or standard.
- Header 1st - Displays the first of four User Data Words of the corresponding packet, in binary.
- Header 2nd - Displays the second of four User Data Words of the corresponding packet, in binary.
- Header 3rd - Displays the third of four User Data Words of the corresponding packet, in binary.
- Header 4th - Displays the last of four User Data Words of the corresponding packet, in binary.
- ECC Status - Indicates the presence or absence of the Error Correcting Code information in the payload.
- Format ID - Indicates whether the packet is for HD, SD, Analog, or Mobile captions.
- Language - Indicates the language code (1st through 8th) of the packet.

- CC Data ID - Indicates the CC Data ID of the packet. Can be one of the following:
  - Exchange Format CC
  - Exchange Format PMI
  - Exchange Format Page 1
  - Exchange Format Page 2
  - Short Form Management Data
  - Short Form Text
  - Undefined or Dummy Data
- Set Mode - Mode can be either Sequential or Buffer.
- Packet Flags - Indicates whether the packet is Leading, End, Intermediate, or Single.
- Checksum - Indicates the checksum word that was recovered from the acquired packet.
- Placement - Can display either OK or ERROR, indicating whether the ARIB B.37 packets are present in the allowable configuration(s) specified in ARIB TR-B.23.

ARIB STD-B.35 Display and Status Screens

The ARIB STD-B.35 display shows the decoded data for video signals using ancillary data compliant with ARIB STD-B.35. (See Figure 47.) When this display is selected, the instrument searches the signal for ARIB STD-B.35 packets using the DID/SDID combinations defined by ARIB.

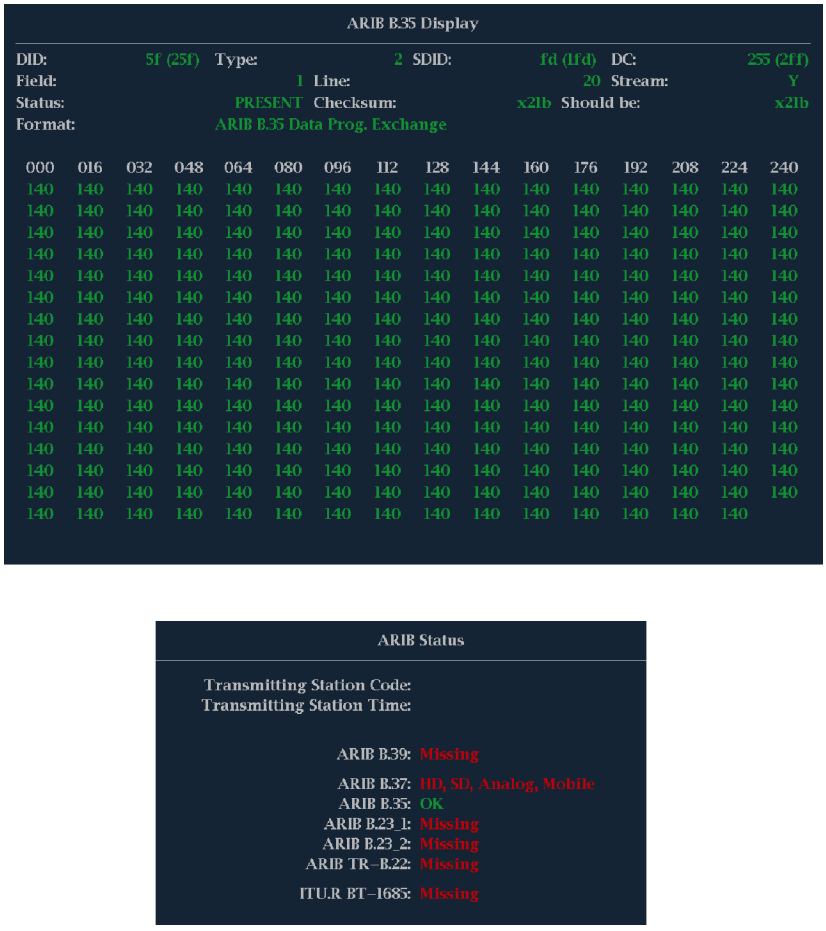

ARIB B.35 Display
DID: 5f (25f) Type: 2 SDID: fd (1fd) DC: 255 (2ff)
Field: 1 Line: 20 Stream: Y
Status: PRESENT Checksum: x21b Should be: x21b
Format: ARIB B.35 Data Prog. Exchange
000 016 032 048 064 080 096 112 128 144 160 176 192 208 224 240
ARIB Status
Transmitting Station Code:
Transmitting Station Time:
ARIB B.39: Missing
ARIB B.37: HD, SD, Analog, Mobile
ARIB B.35: OK
ARIB B.23_1: Missing
ARIB B.23_2: Missing
ARIB TR–B.22: Missing
ITU.R BT–1685: Missing

Figure 47: ARIB STD-B.35 display (with the associated ARIB Status display)

The decoded ancillary data includes the following:

- DID - Data Identifier of the requested packet; permissible values range from 1 to 0xFF (255) inclusive.
- Type - Type of the ANC Data packet. For ARIB B.35, this is always a Type 2 packet (DID less than 0x80), as defined by SMPTE 291M. The actual value (with parity bits added) is displayed in parentheses.
- SDID - Secondary Data Identifier of the requested packet; permissible values range from 0 through 0xFF (255) inclusive. This field only appears when a Type 2 packet is selected (see above). The actual value (with parity bits added) is displayed in parentheses.

- DC - Data Count word of the acquired packet. The number of User Data words is displayed in decimal. The actual value (with parity bits added) is displayed in parenthesis, in hexadecimal.
- Field - The field of the video from which the packet was acquired. Displays 1 for progressive formats.
- Line - The line of the video (within the field) from which the packet was acquired.
- Stream - For HD (SMPTE 292M), indicates whether the ancillary packet was acquired from the Y or C data streams. Displays N/A for SD.
- Status - Indicates whether packet(s) of the desired type are present in the video; also indicates Checksum or CRC errors.
- Checksum - Indicates the checksum word that was recovered from the acquired packet.
- Should be - Indicates the checksum word computed by the instrument, based on the packet data.
- Format - Indicates the name of the ancillary data type or standard.
- User Data Words - Contains the payload of the ancillary packet, displayed in hexadecimal. Displays all 10 bits.

ARIB TR-B.23 (1) Display and Status Screens

The ARIB TR-B.23 (1) display shows the decoded data for video signals using ancillary data compliant with ARIB TR-B.23 (1). (See Figure 48.) When this display is selected, the instrument searches the signal for ARIB TR-B.23 (1) packets using the DID/SDID combinations defined by ARIB.

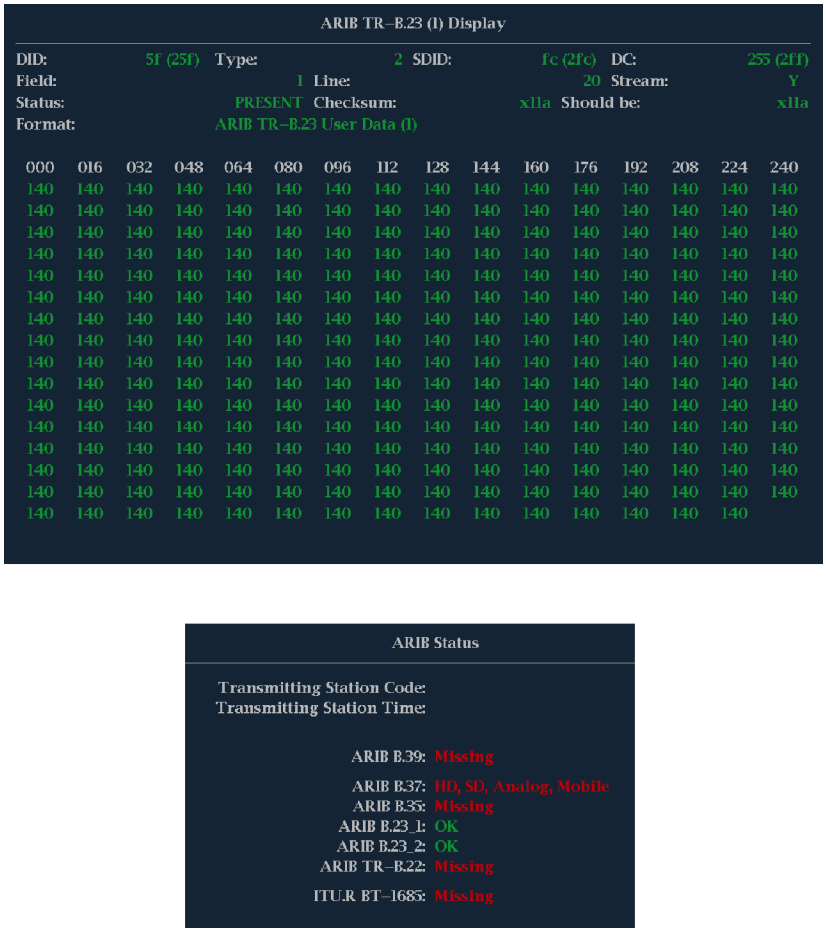

ARIB TR–B.23 (1) Display
DID: 5f (25f) Type: 2 SDID: fc (2fc) DC: 255 (2ff)
Field: 1 Line: 20 Stream: Y
Status: PRESENT Checksum: x11a Should be: x11a
Format: ARIB TR–B.23 User Data (1)
000 016 032 048 064 080 096 112 128 144 160 176 192 208 224 240
ARIB Status
Transmitting Station Code:
Transmitting Station Time:
ARIB B.39: Missing
ARIB B.37: HD, SD, Analog, Mobile
ARIB B.35: Missing
ARIB B.23_1: OK
ARIB B.23_2: OK
ARIB TR–B.22: Missing
ITU.R BT–1685: Missing

Figure 48: ARIB TR-B.23 (1) display (with the associated ARIB Status display)

The decoded ancillary data includes the following:

- DID - Data Identifier of the requested packet; permissible values range from 1 to 0xFF (255) inclusive.
- Type - Type of the ANC Data packet. For ARIB TR-B.23-1, this is always a Type 2 packet (DID less than 0x80), as defined by SMPTE 291M. The actual value (with parity bits added) is displayed in parentheses.
- SDID - Secondary Data Identifier of the requested packet; permissible values range from 0 through 0xFF (255) inclusive. This field only appears when a Type 2 packet is selected (see above). The actual value (with parity bits added) is displayed in parentheses.

- DC - Data Count word of the acquired packet. The number of User Data words is displayed in decimal. The actual value (with parity bits added) is displayed in parenthesis, in hexadecimal.
- Field - The field of the video from which the packet was acquired. Displays 1 for progressive formats.
- Line - The line of the video (within the field) from which the packet was acquired.
- Stream - For HD (SMPTE 292M), indicates whether the ancillary packet was acquired from the Y or C data streams. Displays N/A for SD.
- Status - Indicates whether packet(s) of the desired type are present in the video; also indicates Checksum or CRC errors.
- Checksum - Indicates the checksum word that was recovered from the acquired packet.
- Should be - Indicates the checksum work computed by the instrument, based on the packet data.
- Format - Indicates the name of the ancillary data type or standard.
- User Data Words - Contains the payload of the ancillary packet, displayed in hexadecimal. Displays all 10 bits.

ARIB TR-B.23 (2) Display and Status Screens

The ARIB TR-B.23 (2) display shows the decoded data for video signals using ancillary data compliant with ARIB TR-B.23 (2). (See Figure 49.) When this display is selected, the instrument searches the signal for ARIB TR-B.23 (2) packets using the DID/SDID combinations defined by ARIB.

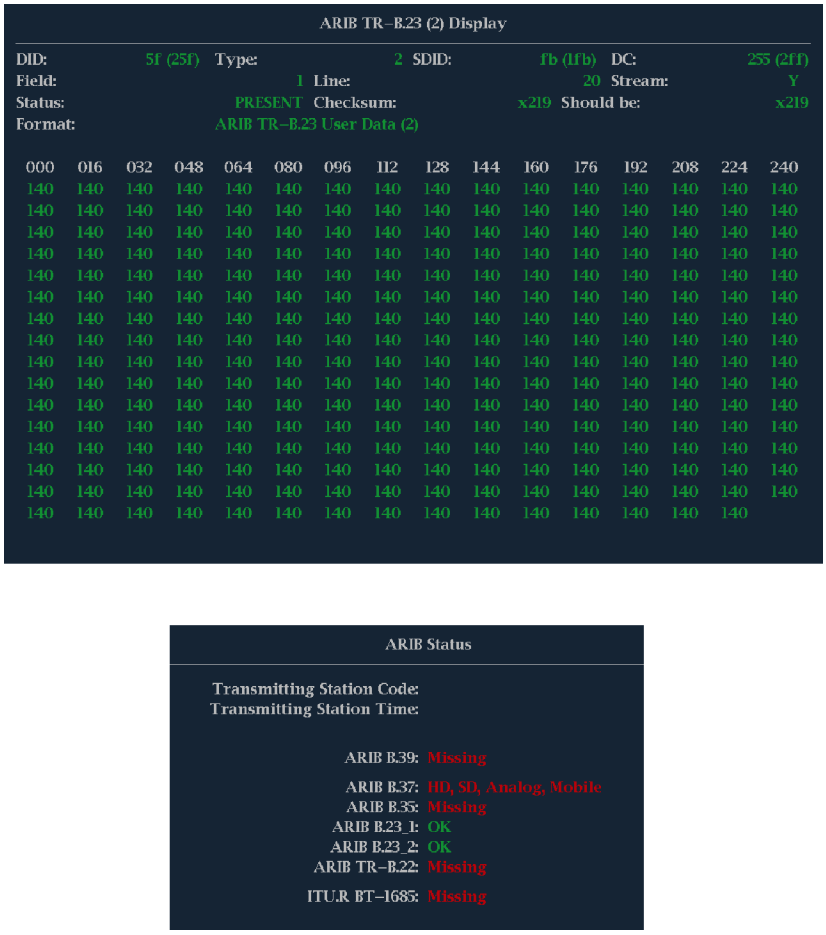

ARIB TR–B.23 (2) Display
DID: 5f (25f) Type: 2 SDID: fb (1fb) DC: 255 (2ff)
Field: 1 Line: 20 Stream: Y
Status: PRESENT Checksum: x219 Should be: x219
Format: ARIB TR–B.23 User Data (2)
000 016 032 048 064 080 096 112 128 144 160 176 192 208 224 240
ARIB Status
Transmitting Station Code:
Transmitting Station Time:
ARIB B.39: Missing
ARIB B.37: HD, SD, Analog, Mobile
ARIB B.35: Missing
ARIB B.23_1: OK
ARIB B.23_2: OK
ARIB TR–B.22: Missing
ITU.R BT–1685: Missing

Figure 49: ARIB TR-B.23 (2) display (with the associated ARIB Status display)

The decoded ancillary data includes the following:

- DID - Data Identifier of the requested packet; permissible values range from 1 to 0xFF (255) inclusive.
- Type - Type of the ANC Data packet. For ARIB TR-B.23-2, this is always a Type 2 packet (DID less than 0x80), as defined by SMPTE 291M. The actual value (with parity bits added) is displayed in parentheses.
- SDID - Secondary Data Identifier of the requested packet; permissible values range from 0 through 0xFF (255) inclusive. This field only appears when a Type 2 packet is selected (see above). The actual value (with parity bits added) is displayed in parentheses.

- DC - Data Count word of the acquired packet. The number of User Data words is displayed in decimal. The actual value (with parity bits added) is displayed in parenthesis, in hexadecimal.
- Field - The field of the video from which the packet was acquired. Displays 1 for progressive formats.
- Line - The line of the video (within the field) from which the packet was acquired.
- Stream - For HD (SMPTE 292M), indicates whether the ancillary packet was acquired from the Y or C data streams. Displays N/A for SD.
- Status - Indicates whether packet(s) of the desired type are present in the video; also indicates Checksum or CRC errors.
- Checksum - Indicates the checksum word that was recovered from the acquired packet.
- Should be - Indicates the checksum work computed by the instrument, based on the packet data.
- Format - Indicates the name of the ancillary data type or standard.
- User Data Words - Contains the payload of the ancillary packet, displayed in hexadecimal. Displays all 10 bits.

ARIB TR-B.22 Display and Status Screens

The ARIB TR-B.22 display shows the decoded data for video signals using ancillary data compliant with ARIB TR-B.22. (See Figure 50.) When this display is selected, the instrument searches the signal for ARIB TR-B.22 packets using the DID/SDID combinations defined by ARIB.

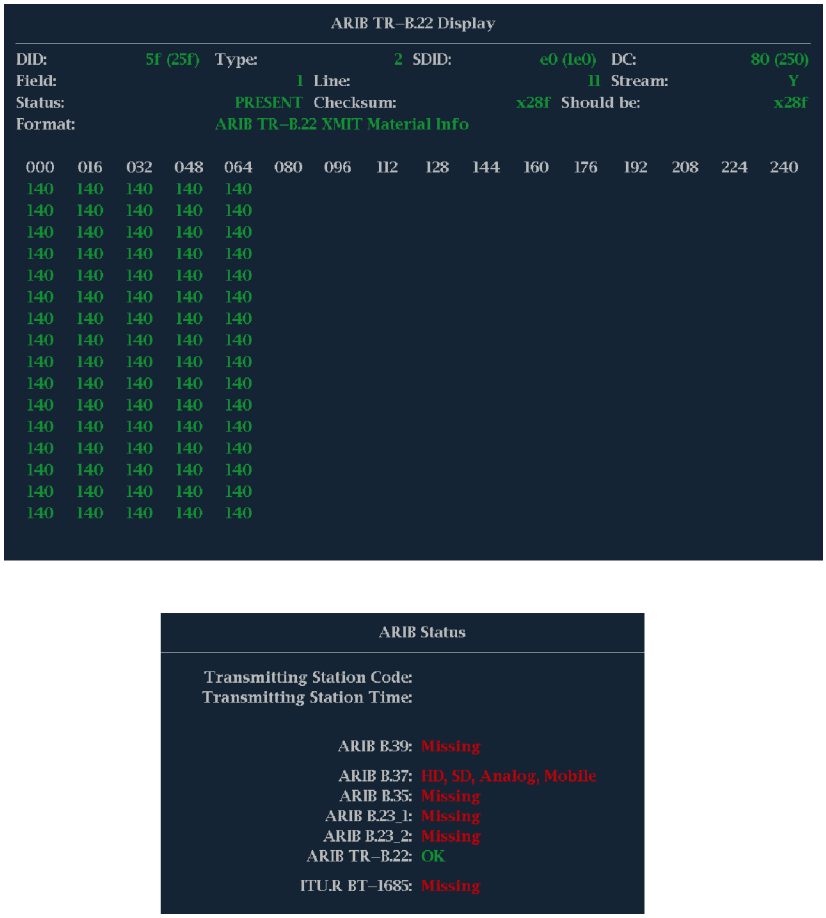

ARIB TR–B.22 Display
DID: 5f (25f) Type: 2 SDID: e0 (1e0) DC: 80 (250)
Field: 1 Line: 11 Stream: Y
Status: PRESENT Checksum: x28f Should be: x28f
Format: ARIB TR–B.22 XMIT Material Info
000 016 032 048 064 080 096 112 128 144 160 176 192 208 224 240
140 140 140 140 140
ARIB Status
Transmitting Station Code:
Transmitting Station Time:
ARIB B.39: Missing
ARIB B.37: HD, SD, Analog, Mobile
ARIB B.35: Missing
ARIB B.23_1: Missing
ARIB B.23_2: Missing
ARIB TR–B.22: OK
ITU.R BT–1685: Missing

Figure 50: ARIB TR-B.22 display (with the associated ARIB Status display)

The decoded ancillary data includes the following:

- DID - Data Identifier of the requested packet; permissible values range from 1 to 0xFF (255) inclusive.
- Type - Type of the ANC Data packet. For ARIB TR-B.22, this is always a Type 2 packet (DID less than 0x80), as defined by SMPTE 291M. The actual value (with parity bits added) is displayed in parentheses.
- SDID - Secondary Data Identifier of the requested packet; permissible values range from 0 through 0xFF (255) inclusive. This field only appears when a Type 2 packet is selected (see above). The actual value (with parity bits added) is displayed in parentheses.

- DC - Data Count word of the acquired packet. The number of User Data words is displayed in decimal. The actual value (with parity bits added) is displayed in parenthesis, in hexadecimal.
- Field - The field of the video from which the packet was acquired. Displays 1 for progressive formats.
- Line - The line of the video (within the field) from which the packet was acquired.
- Stream - For HD (SMPTE 292M), indicates whether the ancillary packet was acquired from the Y or C data streams. Displays N/A for SD.
- Status - Indicates whether packet(s) of the desired type are present in the video; also indicates Checksum or CRC errors.
- Checksum - Indicates the checksum word that was recovered from the acquired packet.
- Should be - Indicates the checksum work computed by the instrument, based on the packet data.
- Format - Indicates the name of the ancillary data type or standard.
- User Data Words - Contains the payload of the ancillary packet, displayed in hexadecimal. Displays all 10 bits.

Audio Monitoring

Your instrument can monitor embedded audio signals if it has Option AUD installed. It can measure levels, monitor phase, display phase correlation, and monitor surround-sound audio. You can specify meter ballistics and scales, set test and peak program indicator levels, and specify how phase is displayed.

NOTE. *The audio monitoring features described in this chapter requires that Option AUD be installed. For a list of the options currently installed on your instrument, press the* ***CONFIG*** *button. In the configuration menu, select* ***Utilities****. The* ***View Options*** *entry lists the installed options.*

Configuring Audio Inputs

Audio inputs come set to factory defaults. As a result, you may need to configure them before performing the audio monitoring procedures in this section. The first procedure helps you configure the inputs. After you have completed that procedure, check that the alarms are configured as you want them. Your setup here determines, in part, which audio-signal characteristics are displayed.

To Set Up an Audio Input

1. Press the **CONFIG** button to display the configuration menu.
2. Select **Audio Inputs/Outputs** and select the input to be configured.
3. Select from **Srnd (Surround)** for a *5.1* or *5.1+2* type display, or **Pairs** for a *stereo with SAP and discrete channels* type installation.
4. Select **Bar to Input Map** and select which input pair should be displayed in each bar pair.
5. Select which inputs are allowed to generate alarms.
6. Select the box to return to the Configuration menu.
7. Repeat these steps for any other Audio inputs.

Selecting Audio Inputs

You select the audio input to be monitored from the front-panel **AUDIO** button pop-up menu. Note that the Audio display can appear in only one tile at a time.

1. Select a tile.
2. Press and hold the **Audio** button to open the Audio display in a tile and pop up the Audio menu.

3. Use the Arrow Keys and **SEL** button to make selections in the steps that follow.
4. Select **Audio Input** and then select one of the audio input options shown.

NOTE. *The available selections depend on the installed audio option. Selecting Follows Video selects the audio to video mapping set in the configuration menu. (See page 115, Configuring Audio Inputs.)*

To Check Audio Level and Phase

Level meters are vertical bar graphs on which the height of the bar indicates the amplitude of the audio program in the corresponding input channel. Use the Audio pop-up menu to change the input and turn on and off the Phase display. Other meter characteristics such as ballistics, scale units, and program and test levels are configured through the Configuration menu.

If your instrument is equipped with optional audio features, it can display phase of one input pair as a Lissajous pattern, and display relative phase on all four pairs of inputs with correlation meters.

To Check Audio Level

1. Open the audio display in one tile and select an input. (See page 115, *To Set Up an Audio Input*.)
2. Check the level meter bars for current audio levels, which are displayed according to the selected meter ballistics. Each bar displays three colors. (See Figure 51.)
   - Green – Indicates audio levels below the test level.
   - Yellow – Indicates audio levels between the test and peak program level.
   - Red – Indicates audio levels above the peak program level.

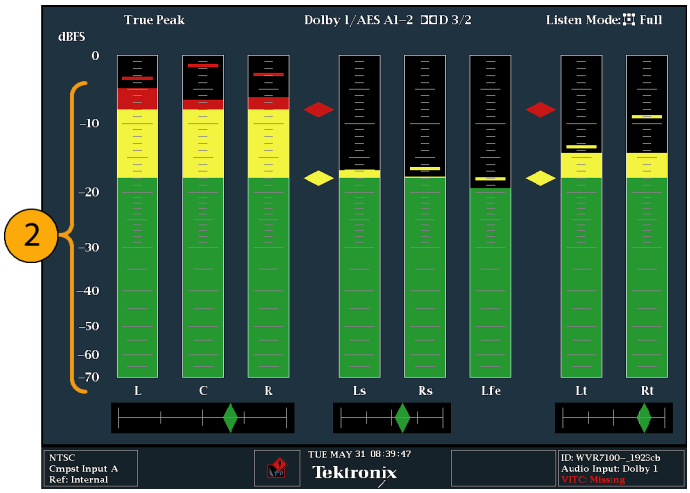


Figure 51: Audio levels

To Check Audio Phase

1. Select **Aux Display**.
2. Select **Phase Display** to turn it on.
3. Select the **Phase Style**. Choose either a **Lissajous Soundstage** or **X-Y** orientation for the Lissajous signal.
4. Select the phase pair to be displayed, or select **Custom** and select independent channels using the Phase Channel A and Phase Channel B entries.
5. Set the Audio Input to match the signal that you are checking (or use the Audio Follows Video mode set in the CONFIG menu).
6. Check for Phase correlation of the signals, noting the following: (See Figure 52.)
   - Phase correlation meters are located under the appropriate bars and one is duplicated under the phase display.
   - For identical and correlated signals, the indicator is white and moves to the right side.
   - For highly correlated signals, the indicator is green and moves to the right side.
   - For uncorrelated signals, the indicator is yellow and tends to stay in the middle.
   - For anticorrelated signals (one goes up when the other goes down), the indicator is red and moves to the left side.

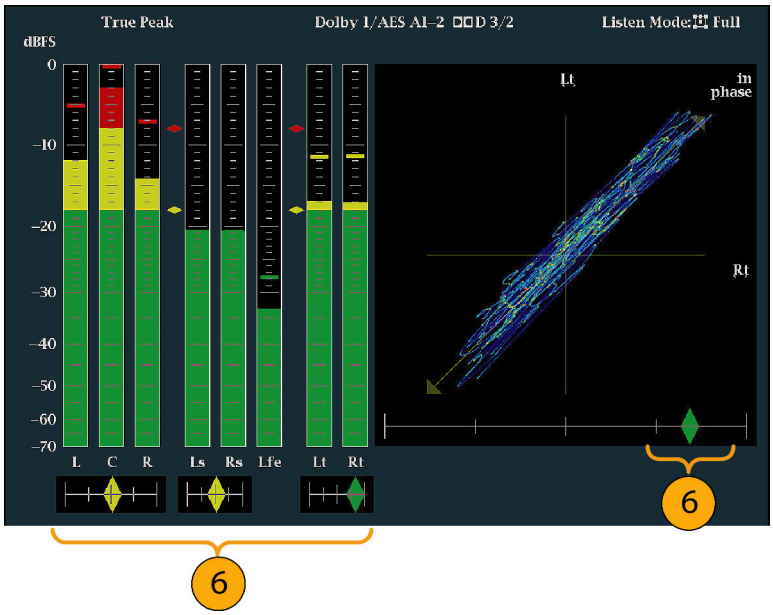


Figure 52: Checking for phase correlation

Usage Notes

- The Lissajous or phase display is a plot of one channel against another on an orthogonal pair of axes.
- Soundstage plots the two channels at 45 degree angles, with the mono combination appearing on the vertical axis– like a left-right image in a studio.
- X-Y plots left-channel data on the vertical axis and right channel data on the horizontal axis, emulating the X-Y display of an oscilloscope.
- The following response times of the correlation meters can be set from the Configuration menu.

Speed setting	Response averaging time (s)	Speed setting	Response averaging time (s)
1	0.0167	11	3.0
2	0.0333	12	3.5
3	0.0667	13	4.0
4	0.1333	14	4.5
5	0.2667	15	5.0
6	0.5333	16	5.5
7	1.0	17	6.0
8 (default)	1.5	18	6.5
9	2.0	19	7.0
10	2.5	20	7.5

To Check Surround Sound

Your instrument can also display the surround sound listening environment. The following procedures help you get started.

1. Open the audio display in one tile and select the input containing the surround audio. (See page 115, *To Set Up an Audio Input*.)
2. Select **Aux Display** and then select **Surround Sound Display**. Press **SEL** or the right-arrow key to turn the phase display on.
3. Set the Audio Input to match the signal that you are checking.

NOTE. *If you want the level bars labeled with their surround sound channel names instead of channel numbers, select* ***Srnd*** *(Surround) when you configure the audio inputs. (See page 115.)*

4. Set the surround **Dominance indicator** to **ON** or **OFF**.
5. Set the **Loudness Filter** to the type preferred. A-Weighting biases the response toward that of human hearing.
6. Use the level bar display to monitor level control. (See page 116, *To Check Audio Level*.)
7. Use the surround display to monitor relative loudness of the individual elements rendered in a surround-sound listening environment. Check the surround sound display for performance parameters and indicators. (See Figure 53.)

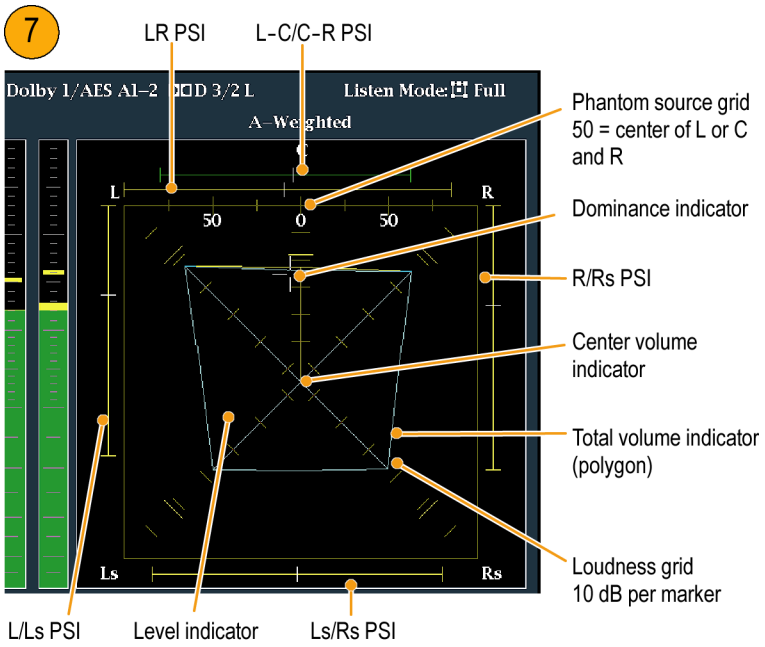


Figure 53: Surround sound indicators

NOTE. *The Audio Surround Sound display is courtesy of Radio-Technische Werkstaetten GmbH & Co. KG (RTW) of Cologne, Germany.*

Elements of the Surround Sound Display

- Level Indicators – indicate the audio level balance among the left (L), right (R), left-surround (Ls), and right-surround (Rs) channels as cyan lines on the Loudness Grid.
- Loudness Grid – the ruled scale, radiating from the center, on which the level indicators register their audio level and balance. The scale has tic marks at 10 dB intervals. An additional tic mark indicates the –18 dB level. The –18 dB and –20 dB levels are typically used for aligning audio levels.
- Total Volume Indicator – the cyan polygon formed by connecting the level indicator end points, showing the total sound volume of the L, R, Ls, and Rs channels. Each connecting line bends away from the center if the two signals have a positive correlation, bends toward the center if the signals have a negative correlation, and do not bend if the signals are uncorrelated.
- Center Volume indicator – displays the sound volume of the center channel as a vertical yellow bar between the L and R channels, and connects the ends of the L, C, and R audio level indicators with straight lines.
- Channel-Pair Phantom Sound Indicators (PSIs) – located on each side of the Surround Sound display, indicates the location of potential phantom sound sources formed by adjacent channels. The white tic marks on these moving bar indicators show the phantom source locations. The bar length indicates

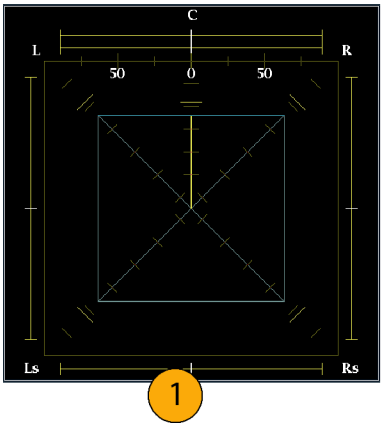
the correlation between the adjacent channels. A short-to-medium length green bar indicates positive correlation between the channels, forming a localized phantom sound source located at the white tic mark. The bar grows to full length and changes color to yellow as the correlation moves to zero, indicating a wide, non-localized sound image. The bar changes color to red for adjacent channels with significant negative correlation. For negative correlations, the ends of the PSI for the L and R channels continue to grow at a 45° angle while the other PSIs remain at full length.

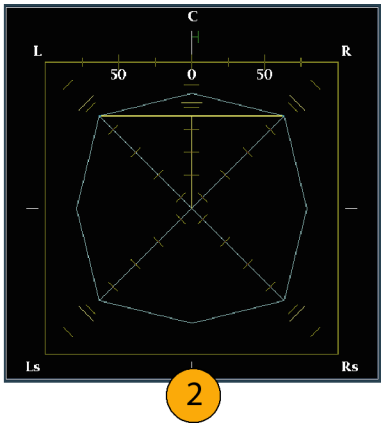
- Center-Pairs Phantom Sound Indicator – a fifth PSI at the top of the display shows potential phantom sources formed by the LC channel pair and the CR channel pair. If the L, R, and C channels all have the same signal level, the white tic mark on the bar appears directly above the C level indicator. The white tic mark moves right or left depending on the relative balance between the three channels. A short bar to the left of the white tic mark indicates a positive correlation between L and C. The bar grows as the correlation decreases. Like the L-R PSI, the bar continues to grow at a 45° angle for negative signal correlations. The bar to the right of the white tic mark behaves similarly, depending on the C-R correlation. This PSI indicator uses the same color coding as the other PSI indicators.

Usage Notes

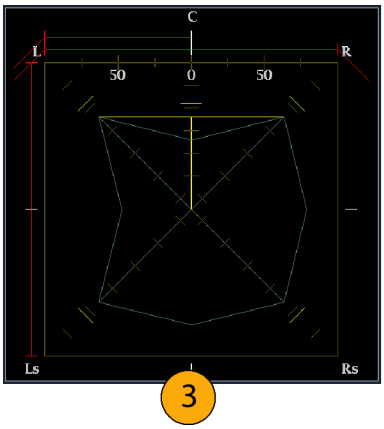
The displays shown here are examples of how the surround sound waveform appears for some typical signal types.

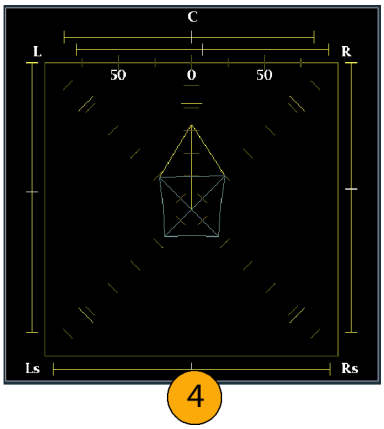
1. Uncorrelated signals: same level in the L, C, R, Ls, and Rs channels.
2. Sine wave test tone: same level in the L,C, R, Ls, and Rs channels. All signals are in phase, creating phantom sources between the adjacent channels.



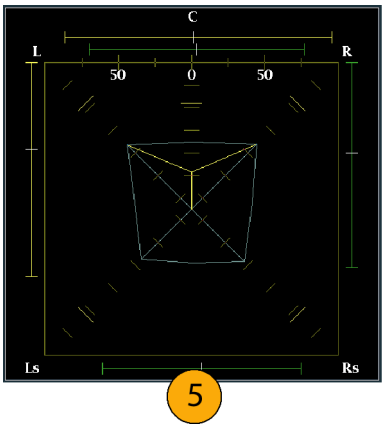


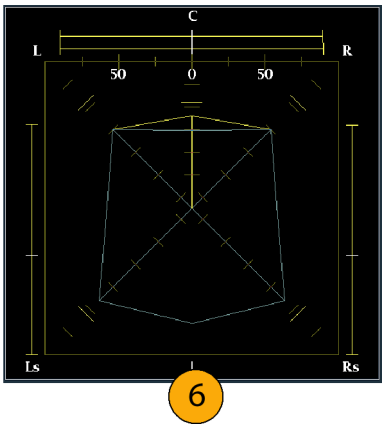
3. Same as 2, with the exception that Channel L is out of phase.
4. Surround sound program with strong center channel presence.





5. Surround sound program with weak center channel presence.
6. Monaural signal in channels Ls and Rs, creating a phantom source in the center, as in a 3.1 surround sound system.





Closed Captioning (CC), Teletext, AFD, and Safe Area Compliance

With Option DATA installed, this instrument can monitor for CC data (including V-Chip ratings) present in the selected signal and display that data overlaid on the Picture display. (CEA 608 (VBI), CEA 608 (ANC), CEA (608/708), CEA 708, TeletextB (VBI), TeletextB OP47 SDP (ANC), and TeletextB OP47 Multi (ANC) closed caption transports are supported.

Your instrument can also display Safe Action and Safe Title graticules, allowing you to monitor for incorrect placements of graphics, logos, and other branding elements. This will help you ensure that those items do not obscure text or essential action. SMPTE, ITU, and ARIB TR-B.4 standards are supported.

NOTE. *CC/Teletext format monitoring is tile specific. To simultaneously monitor more than one format, select the appropriate settings in the desired tile.*

Monitoring CC and Teletext

Perform the following procedures before monitoring CC and Teletext.

To Configure CC and Teletext

1. From the CONFIG menu, select **Aux Data Settings**.
2. Select from the following CC types:
   - CEA 608 Settings (See page 123.)
   - CEA 708 Settings (See page 124, *Configuring CEA 708 settings*.)
   - Teletext B Settings (See page 124, *Teletext b settings*.)

Configuring CEA 608 settings.

1. Select **CEA608 Settings** from the Aux Data Settings submenu.
2. Select **CEA608 Required** and then select **Yes** or **No**, depending on whether you want to monitor for required settings.
3. Select **CEA608 Transport**, and then select from Auto, Line 21, S334 (RAW), or S334 (CDP). If you select **Auto**, the instrument will search for any available transport.
4. Select **VBI Mode**, and then select Auto or Manual. If you select **Manual**, set **VBI Line Num** using the General knob.

5. Select **VBI Timing** and select Normal, Early, or Late.
6. If required services is set to Yes, select **Req Services** and press the **SEL** button. This will show a dialog box that allows you to select CC and Text required channels.

Configuring CEA 708 settings.

1. Select **CEA708 Settings** from the Aux Data Settings submenu.
2. Select **CEA708 Required** and select **Yes** or **No**, depending on whether you want to monitor for required settings.
3. If required services is set to Yes, select **Req Services** and press the **SEL** button. This brings up a dialog box that allows you to select CC and Text required channels.

Teletext b settings.

1. Select **Teletext B Settings** from the Aux Data Settings submenu.
2. Select **Teletext Required** and select **Yes** or **No**, depending on whether you want to monitor for required settings.
3. Select **WST Transport**, and select from Auto, VBI, OP47 (SDP), or OP47 (Multi). If you select **Auto**, the instrument searches for any available transport.
4. If required services is set to Yes, select **Teletext Req Pages** and press the **SEL** button.
5. When Teletext Required Pages dialog box appears, use the General knob to navigate to the box in the **Allow Alarm** column that is next to the page for which you want monitor.
6. Press the **SEL** button to mark the box.
7. Press the right arrow key and then press the SEL button to highlight the **Page Number** box.
8. Use the General knob to set the box to the desired page number and press the **SEL** button.
9. When you are finished with your selections, use the down arrow to navigate to the **Return** box and press the **SEL** button.

To View CC Status and Subtitles

1. Select a tile.
2. Press and hold the **STATUS** button to display the Status pop-up menu.
3. Select **Display Type**.
4. Select **Aux Data Status**. The Auxiliary Data Status display shows the status of the closed caption data. (See Figure 54.)

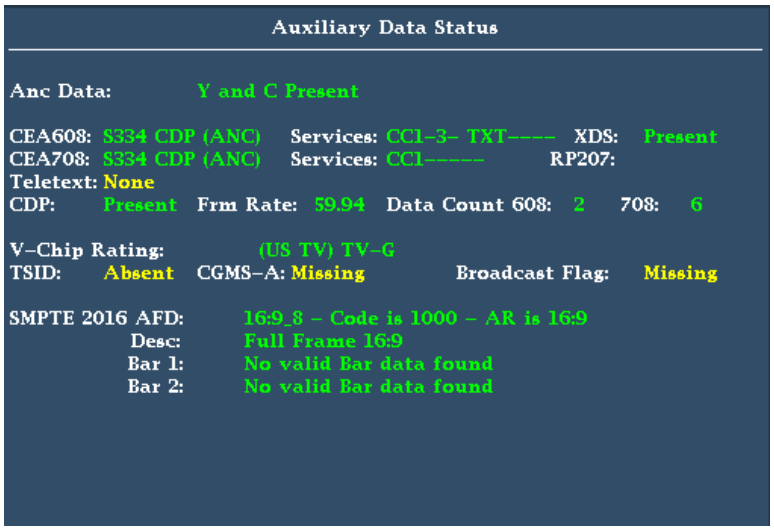

Auxiliary Data Status
Anc Data: Y and C Present
CEA608: S334 CDP (ANC) Services: CC1–3– TXT---- XDS: Present
CEA708: S334 CDP (ANC) Services: CC1----- RP207:
Teletext: None
CDP: Present Frm Rate: 59.94 Data Count 608: 2 708: 6
V–Chip Rating: (US TV) TV–G
TSID: Absent CGMS–A: Missing Broadcast Flag: Missing
SMPTE 2016 AFD: 16:9_8 – Code is 1000 – AR is 16:9
Desc: Full Frame 16:9
Bar 1: No valid Bar data found
Bar 2: No valid Bar data found

Figure 54: Auxiliary Data Status display

To Display CC

1. Select a tile.
2. Press and hold the **PICT** button to display the Picture pop-up menu.
3. Select **CC/Teletext Format** and select the CC type, if any, you want to display.
4. Select the channel, service, or page to display.

   The Picture display includes Closed Captioning in the area designated by the Closed Caption data. (See Figure 55.)
5. Press the **PICT** button again to dismiss the Picture pop-up menu.

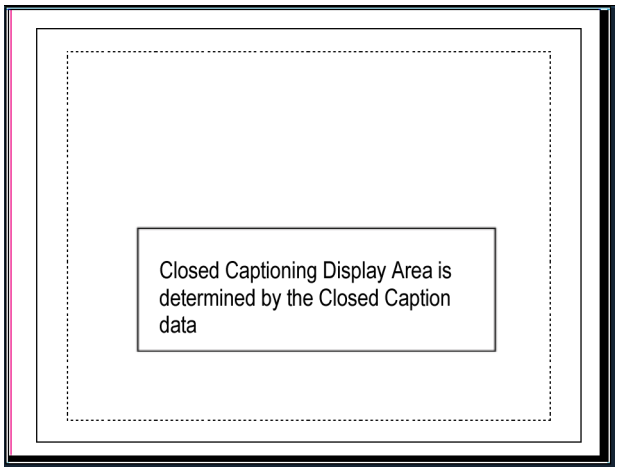


Figure 55: Closed caption display area

Usage Notes

- PICT displays in individual tiles allow their Services and Pages to be selected independently.
- CC text is not captured with the Picture image when using Freeze.
- CC/Teletext setups are also stored when saved with Presets and restored at power on.
- The CC alarms are available from the Configuration menu in the Alarms submenu under Closed Captions/Metadata.
- Teletext can be viewed as captions or as a whole page.

Monitoring for Safe Area Compliance

To display graticules for monitoring for incorrect placements of nonessential elements relative to essential ones, set global settings in the Configuration menu and turn on up to four Safe Area graticules, each with independent settings, in the Picture menu.

To Configure Safe Area Graticules

Before using Safe Area Graticules, configure them from the Configuration menu by performing the following steps:

1. Select **Graticules** and then select **Safe Area Graticule Standard** from the CONFIG menu.
2. Choose from the **SMPTE**, **ITU**, or **ARIB TR-B.4** standards. The selection you choose will be the graticule used when **AUTO** is chosen for any of the four Safe Area Graticules, accessed in the Picture menu.
3. To set the Height, Width, and Offsets of the title and action areas for Custom Safe Graticules 1 and 2, first select the title or action to change.
4. Set the percentage level for each of the parameters. Parameters are set as a percentage of screen height or width, and you can watch the graticules update on the screen as you change them.

NOTE. *The custom parameters you set are used when* ***Custom_1*** *or* ***Custom_2*** *is chosen for any of the four Safe Area Graticules accessed in the Picture menu.*

To Display Safe Area Graticules

1. Select a tile.
2. Press and hold the **PICT** button to display the Picture menu.
3. Select **Safe Area Action 1**.

4. Select one of the following:
   - **Auto** to let the instrument automatically select the size and offsets of the safe area.
   - **4x3**, **14x9**, or **16x9** to set the safe area size and offsets appropriate for these aspect ratios based on the selected standard.
   - **Custom_1** or **Custom_2** to set the safe area size and offsets to match the custom settings in the Graticules Configuration menu.
5. After setting each Safe Area selection, press the **PICT** button to dismiss the pop-up menu.

Usage Notes

- The Safe Action Area shows the maximum image area within which all significant action should be contained; the Safe Title Area shows the maximum image area within which all significant titles should be contained. (See Figure 56.)
- Safe Area Graticules can globally be configured to comply to accepted standards in the Configuration menu.
- Custom selections for vertical and horizontal size and offset of the Save Areas can be set in the Configuration menu.

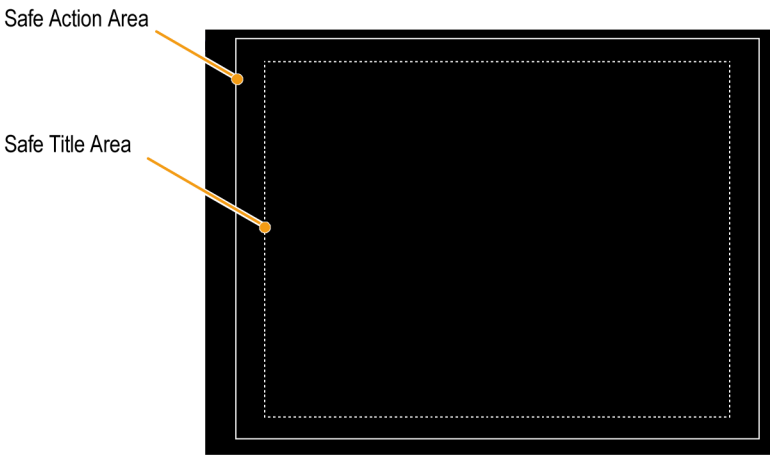


Figure 56: Safe Action and Safe Title areas

Monitoring for AFD Compliance

To display graticules for monitoring for AFD compliance, you must turn the graticules on from the pop-up menu in the Picture Display. View information about AFD graticules on the Auxiliary Data Status display.

To Configure AFD Graticules

1. Press and hold the **PICT** button to display the Picture menu.
2. Select **AFD Graticules** and then select **On**.

   View the graticules in the Picture display. AFD information can viewed in the Auxiliary Data Status display. (See Figure 54 on page 125.)

Application Example

Timing a Studio

Your instrument supports multiple methods and techniques for timing a studio, all of which require an external reference to your instrument. Timing a studio involves adjusting the references going to different sources so that their output feeds have the same timing when they arrive at a common point, such as a production switcher. For digital systems, timing typically must be close, but not exact, because most switchers have some tolerance for timing errors. For analog composite systems, the timing may need to be matched within a small part of a subcarrier cycle to prevent hue shifts when switching between sources.

Following are procedures for timing a studio using various methods.

Using the Traditional Method

Your instrument makes the traditional method of comparing Horizontal and Vertical timing easier by providing flexible tiles and a Freeze function. To time a studio using the traditional method, you store an input as a baseline and compare signals that you time against the baseline.

1. Select a tile in which to time the active input. Select **WFM**.
2. Apply the first input signal to the appropriate input, terminate it properly, and select it.
3. Push and hold the **WFM** button. From the **Display Mode** submenu, select a display mode that is appropriate to the signal that you input.
4. Apply the house reference signal to the external reference input, terminating it properly.
5. Press the **EXT REF** button to select External Reference mode. (Connected to the house reference.)
6. Put the selected tile in line mode Using the **SWEEP** button menu.
7. Use the **HORIZONTAL** knob to center the sync edge or the SAV pulse. (If using the SAV pulse, turn off Stripping EAV/SAV/ANC in the SDI Input setting of the Configuration Menu.)
8. Press the **MAG** button to increase the timing resolution.
9. Activate another waveform display in a second tile.
10. Press and hold the **SWEEP** button and select **FIELD** to put the display in field mode.
11. Use the **HORIZONTAL** knob to center the vertical interval.
12. Press the **MAG** button to increase the timing resolution.
13. Press the **CAPTURE** button to save the waveform as a baseline.

14. Apply an input that must match timing of the first input.
15. Adjust the timing offset of the signal being timed to match the timing to the saved baseline.
16. Repeat steps 14 and 15 for any other required signals.

NOTE. *Use the Cursors as markers or to measure timing differences between sources.*

Other tiles can be used to set fine timing and check color frame alignment on composite signals. Alternatively, the other two tiles could be used for line and field rate displays without Mag active to show the location of significantly mistimed signals.

Using the Timing-Display Method

The Tektronix Timing Display provides a quick, easy way to measure the timing of an input relative to the external reference:

- The rectangular display automatically scales to match the input signal. For progressive signals, the display represents one field; for interlace signals, the display represents one frame; and for composite inputs, the display represents one color frame.
- The cross-hair in the center represents zero offset, and the circle represents the timing of the input signal. Lines of advance or delay are shown as vertical displacement, while timing errors of less than one line are shown as horizontal displacement. If the input is at the same time as the reference, then the circle will be centered on the cross-hair.
- The timing offset is also shown numerically as lines and micro-seconds of advance or delay in the boxes at the right side of the display.
- For input and reference signals with closely related frame rates, there is only one timing relationship, so a single circle is shown on the display to indicate the timing offset of the input signal.
- For input and reference combinations with more complex relationships, multiple circles are displayed to indicate all the possible interpretations of the timing offset, with the one that is closest to zero shown with emphasis. The numerical readouts will correspond to the timing indicator circle with the emphasis.
- The **Relative to:** box indicates the chosen zero point for the timing display. The default is Rear Panel. In this mode, the offset is zero when the input and reference are at the same timing at the rear panel of your instrument. The other choice is Saved Offset. In this mode, you can save the timing from one signal and then display the timing relative to that saved offset.

To use the Timing display to time a signal to a reference.

1. Select a tile in which to time the active input.
2. Apply the input signal to be timed to the appropriate input, terminate it properly and select it.
3. Apply the house reference signal to the external reference input, terminating it properly.
4. Press the **EXT REF** button to select External Reference mode.
5. Press the **MEAS** button to select the Timing display for the tile selected in step 1.
6. If only one circle is displayed, adjust the timing offset of the black generator to match the timing to the external reference. Adjust for a perfect coincidence of the circle around the reference target (circle turns green at coincidence) and null values of the vertical and horizontal timing readouts.
7. If multiple circles are displayed, the timing is complex, and you must choose the one you want. The measurement that is closest to zero offset is displayed with emphasis and appears in the readouts.

NOTE. *See Timing Displays for Simple Versus Complex Timing for more information about complex timing displays and their elements.* *(See page 42.)*

9. Repeat step 6 or 7 for any other signals.

NOTE. *As you adjust timing, the circle representing the input timing may jump occasionally. This is because the color frame detection circuit can be temporarily disrupted as the signal shifts. The jump is often a multiple of the field time. The circle will settle back to the correct location in a second or so.*

Timing Multiple Inputs to a Router

Use the **Relative to:** function to set the offset between a master signal and a reference signal as the zero-point reference for time-down applications. The **Relative to:** box indicates the chosen zero point for the timing display:

- **Rear Panel.** In this mode (default), the offset is zero when the measured signal input and reference are at the same timing at the reference at the instrument rear panel. This setting was used in the Timing Display Method procedure.
- **Saved Offset.** In this mode, you can save the timing from a master signal relative to the reference as the zero point offset. Then route other inputs and measure relative to this saved offset.

To time the inputs to a router.

1. Perform steps 1 through 5 of the previous procedure.
2. Route the signal you want as the master to the appropriate input, SDI or Composite, and terminate properly.
3. Route the reference signal to the reference input and terminate appropriately.
4. Save the timing offset for the master input (**MEAS > Save Offset > SEL**) and select the **Relative to: Saved Offset** mode from the pop-up menu.

NOTE. *You cannot save the timing offset if either the input or reference is missing or unlocked. You also cannot save a reference when in internal mode. Saving an offset in these conditions would lead to misleading results so it is not allowed by the instrument. A warning message will appear on the screen if you attempt to save the offset when it is not allowed.*

5. Now select other inputs to the router to be connected to the instrument. For each input, the relative timing will be displayed.
6. Adjust the timing offset at the master sync source to time down the inputs to the router to match the master.

Usage notes.

- The resolution of the timing display for SD signals is one 27 MHz clock cycle or 37 ns. For HD signals, it is one clock at 74.25 MHz, which equates to about 13.5 ns. To get the greater accuracy needed for a composite signal, first use the timing display to get close, then use a vector display for the final burst phase alignment. Since the instrument can display both the timing display and a vector display simultaneously (each in its own tile), this process can still be easy and quick.
- For an SDI input relative to an analog reference, the situation is more complex. For the timing display, three definitions of "zero offset" on an SDI input are supported, Analog (DAC) and Serial (0H) and Saved Offset.

  The **Analog (DAC)** setting uses the methodology illustrated in appendix B of SMPTE RP168. This method shows the SDI signal being converted to analog. The converted analog signal is then compared to the analog reference. For this mode the nominal delay of the D to A converter is assumed to be 4.6 microseconds for SD, 1.3 µs for HD and 0.0 us for 3 Gb. The 0.0 µs delay for 3 Gb means the Analog (DAC) and Serial (0H) modes are equivalent for 3 Gb signals.

The **Serial (0H)** setting, uses the methodology implied in appendix A of SMPTE RP168. In this mode timing is considered to be zero when the 0H sample of the serial stream aligns with the reference edge of the analog sync. Note that this timing is actually at the scrambled interface which is slightly different than timing to the parallel data into the serializer or the parallel data out of the deserializer due to delays in those functions.

- In the **Relative to: Rear Panel** mode, this 3 µs conversion delay is removed from the measured offset before the display is generated. In the **Relative to: Saved Offset** mode, it has no effect.

  In the **Relative to: Saved Offset** mode, the timing of one signal is "saved" and then that becomes "zero" for subsequent measurements. This removes any need for a specific definition of zero timing, since the display shows the difference in timing between the initial and current signals.

- This timing relationship between input and reference is also compatible with the waveform mode. That is, if you have zero timing on the Timing display and change from internal to external reference, the displayed waveform will not shift position.

NOTE. *If you have an input and reference combination that requires multiple timing indicator circles, then it can be misleading to compare timing offsets between multiple inputs. Because the timing display chooses the smallest of the possible timing offsets, if a large timing difference exists between two inputs, then they may not be matched. This problem also occurs using traditional timing methods unless you use something similar to the SMPTE318 10 field flag to identify a specific sub-multiple of the reference.*

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